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THE EXTORTIONATE "HERALD."

We note that our esteemed and excellent daily contemporary is "running amuck" in a series of virulent attacks upon the electric lighting and telephonic systems in New York City. It does not mince its language; it does not minimize its allegations; it does not moderate its rhetoric; it does not weary in its misrepresentations of the facts. The telephone service is bad; the rates are too high. The electric lighting service is a monopoly, and its meters are not true. This is the burden of its song, and it cries "trust" and "reform" until it has almost persuaded itself that there are real grievances, and that it is doing a public benefit by agitating itself and the subject.

We are not compelled to take the opposite view by any direct or malign influence that we are aware of. Knowing the real facts of the case, we consider and believe firmly that as to both the electric light and the telephone New York is getting about the best and cheapest service yet achieved anywhere in the world. Moreover, the rates are being reduced all the time. We are quite aware that the companies are liable to error; that they are not conducted as charitable institutions; that with them business is not philanthropy; but our observation in many countries and many cities compels us to a frank avowal of the conviction that all things considered and the undeniable dearness of New York admitted, Manhattan Island is very well treated as to traction, telephony and illumination. In these respects we think our opinion is worth a good deal more than that of the *Herald*.

But let us look at the *Herald* itself—one of the best newspapers the world has seen—but notoriously extortionate. It charges three cents for its daily issue, where other admirable journals like the New York *Times* charge but one. There is no redress; you either pay it or you leave it. The telephone and lighting companies make rebates and discounts, but not the *Herald* to any individual consumer. What right has the *Herald* to attack the lighting and telephone systems when it charges three cents for the same service other papers modestly take one cent for? Talk about extortion! The *Herald* is in this sense the worst example on Manhattan Island.

And then as to meters. The *Herald* has advertising rates. They are based on its own reading of its own meters. So far as we are aware or can find out, the *Herald* has based its rates on the alleged highest readings of its circulation meter, and again there is no redress against such extortion. You take it or leave it, just as you do the electric light and the telephone, which are exactly in the same class as desirable, but not absolute, necessities. Possibly the *Herald* circulation meters "read true." Who knows? Why does it not do the proper thing and have its meters checked so that the purchaser of advertising space may know how great the extortion is—or is not—that is practised on him? If the *Herald* would only indulge in a little of the cheapness and truth-telling and essential fairness to the community that it preaches in its malicious attacks on the public service corporations, our estimation of it, though that may not count for much, would be even higher than it is to-day. The lighting and telephone rates will be voluntarily reduced again long before the *Herald* makes any cut, but the *Herald* will still avoid studiously giving any credit for service that is the admiration of every disinterested expert.

Some Weak Points in Street Lighting.

A city street in some respects is the most difficult problem in lighting which the engineer has to face. In a truly metropolitan center where the amount of stray light from buildings is considerable, one can manage the situation with comparative ease, but in the ordinary street in which the only light of any account is that furnished by the public lamps, the difficulties begin. In the first place, the total amount of lighting provided for is generally inadequate and its proper distribution to produce the best results is very troublesome. For a good many years the problem has been studied, but we are bound to say that the solutions proposed have generally been very imperfect. Of late there has been a tendency toward the use of small arcs comparatively near together, thus securing a higher average illumination with a lower value of the maximum. Up to a certain point there is certainly a gain by such an arrangement in spite of the lessened efficiency of arcs as their power is reduced. The additional factor in the case to which we desire to draw attention is the illuminating effectiveness of street lights of whatever kind, as distinguished from their mere candle-power and distribution. In street lighting as in interior work, the real purpose is adequate illumination, not alone the delivery of luminous energy, and good illumination in both cases is a somewhat difficult problem. It is certainly not enough to deliver a specified number of candle-power per mile of street or to supply a particular minimum or average in candle-feet. As lighting contracts are generally drawn, a certain number of lights of specific candle-power are required, distributed according to the directions of the local authorities, which directions are in nearly every case rank guesswork.

The common council of the average city is not composed of technical experts, to put it mildly, and a vote to place an arc light in front of Councilman Flaherty's sample room does not always mean a gain to public lighting. It strikes us that in most instances the company engaged in public lighting could to great advantage be given much more discretion in the matter of placing lights than is now usual. And on the part of the company this discretion would, we think, lead to much better average results than are usually attained. From a technical standpoint there is undoubtedly a chance for gain in a somewhat greater subdivision of the light than is now usual, providing that it is wisely done. It certainly would be very desirable to have more than one light effective at any given point, and some subdivision is needed to secure this advantage. In many instances much more effective use of reflectors than is now usual could be made. One has only to note from a distance the powerful glow over a city even in the suburban portions where the main light is from the street lamps, to realize that a great amount of energy is being wasted. The rays near and above the horizontal are of no practical use in street lighting and ought to be saved for a better purpose. It is a great pity that incandescent street lamps are in such general disfavor, but lacking these admirable work can be done with the arcs of moderate power. The recent researches on enclosed arcs of moderate power with high current density in the arc ought to lead to practical results in street lighting. Enough efficiency can be gained to offset the somewhat greater labor of trimming, and by this means the same energy can be applied to a greater number of illuminating units without sacrificing anything. Arcs of small amperage are now very often exceedingly bad in color, but if worked with carbons somewhat smaller in diameter they would lose this disadvantage and could be made to give greatly improved illumination. Of course, subdivision can be pushed too far, but in practice there is little temptation to do so, and judicious subdivision will do much good. The greatest improvement can be made by the skillful use of reflectors and the arrangement of the lights, so that they shall reinforce each other instead of providing glaring light from the wrong direction.

Two-Motor and Four-Motor Equipments.

Mr. Crawford's recent Institute paper, an abstract of which, together with the following discussion, appears elsewhere, represents a class of work that is useful as putting down in hard uncompromising figures the facts which are *à priori* probable but hitherto undemonstrated. A few years since the arbiters of fashion in electric matters decreed that four-motor equipments were to be the vogue, just as the inner circle of haberdashers concurrently decided that figured white waistcoats were to be worn by fastidious "dressers." Undoubtedly the four-motor equipment was (and is) an excellent thing for people that need that sort of thing, but as in other matters of fashion, it was taken up by many to whose use it was quite unfitted. On broad grounds the greater the output of an electrical unit, the better its efficiency is likely to be at suitable loads, and the simpler the equipment of a car the better. For certain classes of work single-motor equipments are still in extensive use often with excellent results. On lines where stops are not too frequent and the speed is maintained for long stretches, a single motor with rheostatic control answers the purpose admirably. When stops are relatively frequent, so that the aggregate acceleration work is rather large and when the same car has to make fast time on suburban lines, it is equally obvious that a series-parallel control with its two motors is necessary. When the same conditions are pushed to an extreme case a four-motor control by driving all the axles gives better acceleration, and also gives a wider range of efficient speed control. In no case, however, should a car be greatly overpowered for its work if a high average efficiency is to be maintained.

These are the simple theses which are the base of such investigations as Mr. Crawford's. The cars which he tested were excellently adapted to bring out the facts, being respectively a normal two-motor, single-truck car, a normal double-truck car together with one precisely similar but with just double the motor equipment in four motors; and finally a somewhat longer double-truck car with a powerful four-motor outfit. Now on a fairly level urban and suburban run a 29-ft. car with 160 rated hp in four motors is, on the very face of things, grossly overpowered for a schedule speed of eight and a half miles per hour, and in the matter of efficiency is clearly out of the running. It is equally clear that a 20-ft. car with two 25-hp motors will carry a fair load on its motors and should have the best of the argument, as the event proved. The real test, therefore, was between the duplicate cars, one with two 35-hp motors, the other with four. Now since each car seated the same number of passengers and had the same standing room, it is not surprising that the car with a total of 70 hp worked more efficiently than the one with 140 hp, the former taking 1.4 kw-hours per car-mile, the latter 1.8 kw-hours. Each required the same labor on the platforms, but since the former cost $3,275 and the latter $4,360, to say nothing of the added up-keep and depreciation on four motors, it is obvious that the four-motor car was misplaced. The one curious feature of the comparison was that at the end of the day's run the maximum temperature of the motors in the latter was quite as high as in the former, although the average temperature was somewhat lower. While this may have been due to accidental conditions of the runs, it would suggest that two motors can be made to pull together better than four, as might be expected.

The single-truck car performed even better than we should have expected. Costing but $2,710, it actually carried a greater total of

passengers on its test runs than either of the others, and did it on 0.69 kw-hours per car-mile. For the service selected as a test it was quite in a class by itself. As Mr. Crawford justly notes, on different service the relative performance of the several cars would have been notably different. It would perhaps have been worth while to go a little further into the differences shown between the single-truck, double-motor car and the double-truck, double-motor car. The difference in the power per car-mile was very great—the respective amounts being 0.69 to 1.40 kw-hours—considering the relative weights and capacities of the cars, and deserves investigation. At speeds mechanically suitable for a single-truck car it has things quite its own way, but there are many cases in which, on account of safety at good speed, a double-truck car is necessary. If there is any serious difference in performance between it and a single-truck car traceable to the fact that only two of the four axles are driven, that difference should be looked into rigorously. Aside from this possibility, it strikes us that there are very few cases outside of extreme interurban conditions in which a four-motor equipment is at present necessary or desirable. One can accelerate with two motors beyond a safe rate for standing passengers, and with a four-motor outfit the car is overpowered in nine cases out of ten. There is just one contingency in which a four-motor equipment is likely to be desirable in ordinary work, and that is in using trailers, a practice which seems again to be increasing. The four-motor car will work at good efficiency enough when loaded, and the trouble at present comes in the difficulty of properly loading it under ordinary working conditions. Give it a capacious trailer, and it is more nearly in its proper field. Even for this work it is possible that a long car with two heavy motors and properly designed trucks might do equally well at a lower cost, and this point should be looked into. Nevertheless, with trailers in use the four-motor car will do well where it otherwise would do ill. Meanwhile, for ordinary street work the ordinary single-truck car with two standard motors seems to have a monopoly of the laurels.

THEORIES OF ELECTRIC CONDUCTION THROUGH LIQUIDS.

In the phenomena of electric conduction an enormous number of different facts have been brought to light during the last century or more. The phenomena are evidently very complicated. When an electric wave travels through free space the propagation is hard enough to understand, but it is at least singularly definite and consistent. When, however, the waves strike matter and are guided by matter, in solid wires, or liquid columns, or tubes containing gas, the phenomena are in many ways very complex and seemingly inconsistent. During recent years the theory of conduction in electrolytes has been called the dissociation theory. It assumes that there can be no conduction in a chemically compound liquid which has all its molecules complete. Thus, the fact that pure water is practically an insulator, is accounted for on the supposition that the atomic bonds connecting oxygen and hydrogen are so strong that all the atoms of these substances found in pure water are tied together molecularly and that there are no separate hydrogen atoms, or separate oxygen atoms, wandering about loose. When, however, some common salt is dissolved in the water, it is supposed that the sodium and the chlorine atoms are partially dissociated by the process, that many molecules of the salt are broken up into these ions, or atoms with their natural electric charges, and that the electric conductivity of salt water is either wholly, or almost wholly, attributable to the migratory properties of these ions under the influence of the potential difference between the electrodes. In other words, the ions are like loose electrified pith balls, which immediately take up orderly movement when the electrodes are charged, the electric current flow through the liquid being the rate of the delivery of charges by the crowd of pith balls swimming along in procession.

A large number of facts have been adduced by different physicists in support of this theory of electrolytic conduction, and the literature on the subject is quite extensive. A large number of exceptions to the collateral propositions involved have also been noted at different times. It has been supposed that these exceptions were attributable to local complications which masked the phenomena under consideration. A bomb has recently been thrown into the camp of the dissociation theory by a paper from Prof. Kahlenberg, read before the Faraday Society. In this paper the author expresses heretical views with regard to the entire doctrine of the dissociation theory. He considers that the exceptions to the rules are so numerous that they refute the rules, and that these rules are actually only exceptions to some other and more reliable theory. The paper does not attempt to set up any theory in place of the one it attacks. It sets up rebellion to the orthodox creed, but gives no theory by way of compensation. As an instance of the degree of dissent laid down in the Kahlenberg paper, the doctrine of osmotic pressure is actually impugned. This doctrine has been built up laboriously by different physicists during the last thirty years. The doctrine asserts that the relatively high osmotic pressures displayed in the Pfeffer porous cylinder are attributable to the virtual behavior of the particles of a dissolved substance as a gas, and that this gaseous pressure will always be manifested when the chamber has walls pervious to the solvent, but impervious to the solute. The paper declares that in view of a number of recent experiments, this doctrine is wholly untenable and that the effect is probably due to the affinity of the membrane for the solvent, so that it sucks in the solvent from the outside; while, at the same time, the affinity of the solute inside for the solvent robs the membrane of its acquisition and piles the solvent up inside. The process of internal accumulation will go on until the affinity of the solvent for the solute is balanced by its affinity for the membrane.

No serious reply seems to have been elicited by this anti-dissociation paper from the true believers of the orthodox theory. There can be no doubt that heterodox views are healthy and stimulating, by inspiring a desire for further inquiry into the experimentally determinable facts for more material in support of either side of the controversy. It is not likely that any completely satisfactory be expected for the present, because our knowledge of matter itself is too superficial to permit of understanding and explaining all the properties of matter. At the same time, the question in dispute is virtually whether the discrepancies from the orthodox theory are sufficiently numerous to destroy the theory, or whether the theory can survive with a goodly appendix of special exceptions. Maxwell's theory of light is a case of similar nature. According to that theory, the optical index of refraction of a transparent substance is equal to the square root of the specific inductive capacity of the substance. A number of agreements with the theory have been found and also a number of discrepancies. If the discrepancies were sufficiently numerous and important, they would, perhaps, render the theory untenable. Nevertheless, the theory holds its own and the discrepancies are attributed to special conditions of interference, not understood or clearly accounted for. For the present, at least, we must expect to find supporters of the dissociation theory of electrolytic conduction, and also of anti-dissociation theorists. It is likely, however, that the process of conduction is essentially the same in solid, liquids and gases, so that whichever process comes clearly within the grasp of a theory will probably settle the dispute for the other processes also.

Bell Telephone Managers' First Annual Convention.

The first annual convention or conference of Bell telephone officials and managers was held at the Claypool Hotel, Indianapolis, Ind., February 21, 22, 23 and 24. There were about 125 gentlemen present and every State from Maine to California was represented. The deliberations were closed to the public and nothing contained in the papers read or discussions following was given out: The questions of rates and finances were not considered during this conference, but the science and art of telephony and especially the betterment of the telephone service were prominent subjects dealt with.

Mr. F. M. Hill, general manager of the Central Union Telephone Company, of Indianapolis, is given credit as being largely responsible for this first general conference and with having provided an excellent programme and successfully managed the convention in both a practical and social way.

The first session was given up to the reading of a paper by H. D. McBride, of the New England Telephone & Telegraph Company on "Selection and Training of Operators," and a general discussion of the paper and exchange of experiences was had. The next paper was presented by A. S. Rogers, of Omaha, on the subject of "Local Service Tests and the Merit System of Grading Operators." The only paper presented in the afternoon session was on the subject of "Local Operating Methods and the Handling of Irregular Calls," by F. P. Valentine, of Boston. During the remaining sessions the following papers were presented: "Toll Service Tests and the checking of Toll Revenue," by M. C. Rority, of Pittsburg. The discussion of this paper was opened by T. B. Doolittle, of Boston, followed by H. H. Kennedy, of New York; A. M. Fisher, of Nashville, and F. P. Valentine, of Boston, and "The Handling of Suburban Toll Traffic," by E. F. Sherwood, superintendent of traffic of the New York Telephone Company. It was asserted that Indiana cities have little suburban toll traffic, but the recommendations for greater efficiency made by Mr. Sherwood aroused much interest among the representatives from the large Eastern cities and Chicago.

"The Center Checking System" was the subject of a paper presented by H. H. Kennedy, assistant engineer of the New York & Pennsylvania Telephone & Telegraph Company. A paper that received considerable attention and discussion was read by A. P. Allen, of Indianapolis, on "Tariff and Routing Systems." This was followed by the final paper on the programme, by J. L. R. Van Meter, of New York, who discussed the subject of "The Handling of Long-Haul Toll Traffic." The closing session was given up to a catechism and technical discussion of the various subjects and the relation they bear to the various branches of the telephone business.

The results of the conference warrant the belief that similar meetings will be held annually, no place having been selected for next year's convention, however. Perhaps the most enjoyable feature of the convention was the banquet tendered the visiting members, at the Columbia Club, by the officials of the Central Union Telephone Company, of Indianapolis. Mr. L. J. Richardson, president of the Central Union Company, presided and also acted as toastmaster. Those who responded to toasts were Mayor J. W. Holtzman, F. P. Fish, president American Telephone & Telegraph Company; A. S. Hibbard, general manager Chicago Telephone Company; A. D. Wheeler, president Chicago Telephone Company; C. E. Yost, president Nebraska Telephone Company; M. R. Thurber, general superintendent New York Telephone Company; Alonzo Burt, president Wisconsin Telephone Company; M. C. Thayer, president Western Electric Company, New York; F. M. Hill, general manager Central Union Telephone Company, Indianapolis, and E. B. Field, president Colorado Telephone Company.

Among those present at the conference, besides those above mentioned were E. J. Hall, vice-president American Telephone & Telegraph Company; Henry M. Watson, president Bell Telephone Company, of Buffalo; C. F. Sise, president Bell Telephone Company, of Canada; George F. Durant, St. Louis, general manager Bell Telephone Company, of Missouri; T. Spencer, general manager Bell Telephone Company, of Philadelphia; B. L. Kilbour, general manager Cincinnati & Suburban Bell Telephone Company; F. H. Bethell, of Washington, general manager Chesapeake & Potomac Telephone Company; Francis A. Houston, of Boston, general manager New England Telephone & Telegraph Company; J. C. Reilly, of Brooklyn, general manager New York & New Jersey Telephone Company, and U. N. Bethell, of New York, general manager of New York Telephone Company.

Tesla Polyphase Patents held to Cover Polyphase Synchronous Motors.

On February 20 Judge Seaman, of the Circuit Court of the United States of the Eastern District of Wisconsin, handed down an opinion holding that the fundamental Tesla patents, issued May 1, 1888, cover the rotary converter and synchronous motor operated by polyphase currents. The defendants to the suit contended that Tesla's invention is the rotating field mode of operation and this is limited to a self-starting motor so operated; that the defendants' synchronous motor with direct-current excitation is not within the invention, being simply a reversed two-phase alternating-current dynamo of the prior art used as a generator; and that the claims in the Tesla patents which introduced "direct-current excitation producing synchronous operation" must be limited to such use after the motor is started by the Tesla means and method and brought up to speed. The court held that if the invention is to be so limited the defendant escapes infringement; on the other hand, if not so restricted, it is equally clear that the claims of the patents are broad enough to reach the defendants' means and method of operation.

The court stated that the Tesla discovery was of means and methods in the polyphase rotating field motor to produce the "whirling field of force," and employment thereof was obtainable with or without direct-current excitation of the armature or secondary element. The fact that its use produced a self-starting motor without the aid of such excitation cannot alone serve to limit the invention to that effect. The theory advanced of the obliteration of the alternating-current magnetization by that of the direct current of the secondary element of the motor, the court held, was not material, as it is unquestionable that the Tesla invention is brought into the operation of the motor and the structure is within the patent description.

As to the Bradley patent, upon which stress was laid in the argument as showing a polyphase machine stated to be adapted for use "as a motor when fed or actuated by alternating currents," this is subsequent in date of patent issue to the Tesla patents, though the original application bears date prior to that of Tesla. The testimony of Mr. Bradley and his attorney cannot affect the interpretation which must be given the disclosure of the invention in the original application, and if such application can be treated as a disclosure of the prior art, it fails to reach the Tesla conception. Its deficiencies in that regard were pointed out in previous suits involving the Tesla patents.

The conclusions of the court are that the defendants' synchronous motor structure and operation are within the generic invention covered by the claims of two of the fundamental Tesla patents; that the invention is utilized in the defendants' motor operation, notwithstanding the introduction of direct-current excitation to make it synchronous in lieu of the full realization of the revolving field effect for self-starting; that such supplemental aid does not escape infringement with or without advantage in such association; and that, in any view the combination patents referred to are not limited to after effect of direct-current excitation, but apply to the defendants' combination.

The parties of the suit were the Westinghouse Electric & Manufacturing Company and the National Electric Company.

LaGrange, Ill., Abandons Municipal Ownership.

The village board of La Grange, Ill., a suburb of Chicago, has decided by a vote of 5 to 1 to sell the city electric light and water plant to the La Grange Service Company. Three years ago the properties controlled under the name of the La Grange Water, Light & Power Company, were sold to the village under an agreement that the village should pay the interest and principal on $260,000 in bonds held by the stockholders.

Since the village has owned the plant it is said to have deteriorated until $50,000 will be required to put it in proper condition. The purchasing company is a subsidiary company of the North Shore Electric Company, one of the companies controlled by the Chicago Edison people.

Hydro-Electric Development at North Mountain, Cal.

Near the confluence of Canon Creek and Trinity River in Trinity County, Cal., is to be found a hydro-electric equipment which stands as a monument to the enterprise and engineering ability of the owners and construction officers. The machinery, which the power house contains, had to be hauled by wagon over muddy, mountainous roads a distance of 62 miles from the railway. In conveying the heaviest piece, which weighed nine tons, sixteen mules were necessary, the trip requiring 12 days.

Across Canon Creek has been placed a diverting dam—a triangular stone-filled crib structure, 16 ft. high and 80 ft. long. A natural impounding basin is formed among the high, rugged Trinity Mountains, where in certain places the snow remains throughout the whole year. The hydraulic features include a ditch 7½ miles long, having an average grade of 9½ ft. per mile. From a small forebay extend two lines of penstock, giving an effective head of 602 ft.

The power house and transformer station are constructed of concrete. Tangential water wheels drive by direct connection two 750-kw, three-phase, Bullock generators, running at 500 r.p.m. and delivering 25-cycle current at 2,200 volts. Two banks of Bullock transformers serve for stepping up the e.m.f. to the transmission value of 33,000 volts. These transformers are of the water-cooled oil type, an extra transformer being held in reserve. The controlling and supervising equipment is located upon two generator, two transformer and one exciter panels, Westinghouse instruments being used.

In erecting the 70 miles of transmission line, trails had to be built for about 50 miles, and four-fifths of all line material had to be packed in on mules. The circuit is composed of No. 3 medium hard drawn copper, spaced uniformly 36 in. between wires. The line is a single three-wire circuit, supported on 9-in. porcelain insulators of the Locke type, the 1½-in. pins being of oiled sun-dried eucalyptus. The poles, of which about 35 are used per mile, are of native red fir, generally 30 ft. long, set 5 ft. in the ground, except at corners, where they are placed 6 ft. deep. For the longest span, 1,500 ft., wooden towers and special strain insulators are used. On the same poles is strung the metallic circuit telephone lines, the wires being transposed every fifth pole. The power wires are transposed one complete turn every three miles.

Along the route of the transmission line are four very rugged mountain ranges, giving a total rise and fall of more than 45,000 ft. in vertical measurement. For about 50 miles, where the line passed through heavy forest, there had to be cleared a space from 100 to 400 ft. wide, depending upon the height of trees. The forest contains red and white pine, spruce and redwood, the largest of the trees measuring 12 ft. in diameter, the average diameter being about 4 ft. Notwithstanding the numerous difficulties, the copper was connected up in 4½ months, exclusive of a two-mile gap through the redwood belt, the possession of which could not be obtained until the eleventh hour. Considering the nature of the country, remoteness from a labor market and the inherent difficulties of the route, the haste with which the line was completed will invite favorable comparison with any similar piece of work in this country, if not in the world. In the face of such forbidding topography, the pole line at no point departs more than 2½ miles from a straight line drawn between the terminii.

At Eureka is located a sub-station containing a steam auxiliary. The electrical equipment includes a bank of three 400-kw General Electric water-cooled oil transformers stepping down the pressure to 2,300 volts, a bank of three 190-kw Bullock transformers, serving a 500-kw Bullock rotary converter, and a motor-generator set to supply 60-cycle current for lighting. The steam auxiliary is composed of a 1,000-hp McIntosh & Seymour tandem-compound engine running at 146 r.p.m. and driving by rope a jack shaft, to which through a jaw clutch is connected the converter, which is operated in parallel with the main generators. For the economical operation of the engine there is installed a self-contained surface condenser. The two B. & W. boilers use oil for fuel, a steel oil tank, 54 ft. in diameter and 25 ft. high, connected by a 7-in. pipe line to a nearby dock serving for the storage of fuel.

For the local transmission lines along or near Humbolt Bay, the e.m.f. has been placed at 10,000 volts, on account of the fact that it was deemed unwise to use a higher pressure throughout the fog belt in the locality.

Contrary to the usual custom in California in regard to the adoption of a frequency of 60 cycles, the frequency here was placed at 25 cycles, on account of the fact that the equipment is designed primary to serve a power load, the lighting load being subsidiary. Aside from the inviting demand for power in and around Eureka, there is promise of a splendid local field for gold dredging operations within a radius of 15 miles from the power house. The low bars of the Trinity, which have previously remained dormant for lack of cheap power, will respond to the presence of this plant, and will yield handsomely with a modern equipment of gold dredges. Such machinery furnishes ideal 24-hour loads.

In point of time consumed, the installation of the hydraulic, electric and steam equipments presents an exceptional record. Active construction was begun on July 1, 1904, and the machinery at both ends was turned over on January 1, 1905—a total of only six months.

The officers of the North Mountain Power Company are John M. Nance, president; George T. Ruddock, vice-president; A. L. Jackman, superintendent, and J. C. Ralston, chief engineer. To the last-named gentleman especially are we indebted for data which rendered possible the preparation of this article.

Meeting of the American Institute of Electrical Engineers.

At the February meeting of the American Institute of Electrical Engineers two papers were read, abstracts of which follow, together with the discussions to which they gave rise. The first of the papers presented was read by Dr. Sheldon in the absence of the author, Mr. N. McD. Crawford, and had for its title "Two-Motor vs. Four-Motor Equipments."

TWO-MOTOR VS. FOUR-MOTOR EQUIPMENTS.

Mr. Crawford deals with the results of certain tests upon a road having light grades and reasonably small line losses, passing through the business center of a city and reaching the residential section. At all hours of the day the service called for a fair average number of stops, and therefore reasonably rapid acceleration, in order to make the time schedule.

Four types of equipment were selected for this service, as follows: Car 169, having a 20-ft. body, single trucks, two 25-hp motors and a gear ratio of 1 to 4.87; car 138, having a 26-ft. body, two trucks, two 35-hp motors and a gear ratio of 1 to 2.82; car 101, having the same length of body and number of trucks as car 138, but having four 35-hp motors and a gear ratio of 1 to 2.82; car 480, having a 29-ft. body, two trucks, four 40-hp motors and a gear ratio of 1 to 3.67.

The service required of these four equipments was exactly the same, namely, 136.5 miles per day at an average schedule of 8.45 miles per hour. From the results of a series of tests on the four equipments the author derives a quantity which he calls the "commercial efficiency" defined as the ratio of H to $A + B + C + D$, where H is the value of actual passengers carried per mile, A is the cost of power per watt-hour at station switchboard, B is the value of seated load, C is platform labor per mile run and D is the interest and depreciation per mile run, figured at eight per cent.

Applying the above formula and substituting values obtained during the tests, the results are as given in the accompanying table, from which it may be seen that car 169 is the most efficient for the service selected. Car 138, although showing a lower commercial efficiency, probably on account of its greater weight, yet accommodates the passengers much better throughout the entire day. Car 480 was the least efficient of those tried, although there was only a short time when all the passengers could not be seated. This car was provided with 33-in. wheels and could have made the time schedule easily with a lower gear ratio.

Car No.	Capacity seats.	Horse-power motors.	Gear ratio.	Total tons.	Total cost.	Cost per seat.	Cost per ton.	Commercial efficiency.
169	26	two 25	1:4.87	9.075	$2,710	$104.23	$298.62	17%
138	34	two 35	1:2.82	12.425	3,275	96.38	263.59	13.11%
101	34	four 35	1:2.82	14.675	4,360	128.23	297.10	12.53%
480	42	four 40	1:3.67	20.680	5,040	120.00	243.71	10.66%

In selecting motors and cars for a chosen route, it will be found necessary to consider the following: (1) Density of population, as governing the size and seating capacity of the car body; the number of stops per mile, and consequently the acceleration; the frequency of service and the speed in miles per hour. (2) The number of trucks and motors, as determining the size and weight of cars selected; the tractive effort and the acceleration. (3) The speed in miles per hour, as determining the number of cars in service; the platform labor; the demand upon power plant equipment; the increased interest charge for line and power plant. (4) The gear ratio as determining the size of motors; the acceleration; the number of stops per mile; the heating of motors and consequent repairs, and additional power station and line requirements.

The paper by Mr. Crawford was discussed by Messrs. A. H. Armstrong, S. T. Dodd and Calvert Townley. Mr. Armstrong said that the contest between two and four-motor equipments had been settled rather definitely in the majority of cases in favor of the four-motor equipment, the fundamental reason being the need of increased traction. In city work the frequency of stops in connection with an exacting schedule calls for acceleration as high as the comfort of passengers will permit, and this can only be secured by the adoption of motors on every axle. In the case of the subway equipment, however, sufficient traction can be obtained to reach the limit of comfort to passengers without equipping all axles with motors. The modern high-speed suburban road, running at times at a rate of 50 to 60 miles an hour with a car weighing 35 tons and upward, demands an equipment for every axle. In such cases the total power per car is from 500 hp upward, and the design of two-motor equipments of 250 hp is almost impracticable in view of the limitations of space allowed by track gauge and wheel diameter. Consequently, the two-motor equipment seems relegated to light city traffic, to roads having a fairly level profile and a schedule that can be accommodated with a moderate amount of acceleration, and to places where the climatic conditions are such as not to affect at times the tractive effort. As to the relative amount of energy consumed by two-motor and four-motor equipments, there is no reason why a car should demand more energy for a given service when equipped with four than with two motors, provided the total weight of the car is the same in each case. In concluding Mr. Armstrong said that the only rational basis of comparison of four and two-motor equipments is in connection with the local conditions under which they would be used. The sentiment, however, of railway managers is growing more and more in favor of the adoption of four motors for single-car operation.

Mr. S. T. Dodd criticised the method of comparing the commercial efficiency of two and four-motor equipments. By another comparison it could have been shown that the cost of operation per seat mile of the four-motor equipment is less than the cost of the two-motor equipment. As two-motor equipments are apt to be more overtaxed than four-motor equipments, the repair bill may be in favor of the latter. Mr. Calvert Townley pointed out that usually when a comparison was made between two and four-motor equipments, they were based upon cases which introduced a number of factors that affected the comparison. Leaving aside these factors, it appeared to be true that with exactly the same total capacity of car, the four-motor equipment is heavier, costs more and takes additional energy in proportion to the additional weight. Furthermore, the maintenance cost is increased, since it takes more shop facilities for four motors than for two motors, and there are twice as many parts requiring attention. The reason of the unmistakable tendency toward four-motor equipment is because the latter gives increased traction, which in many cases is a valuable feature. Under the ordinary conditions of summer service, where the grades are not severe, there are few conditions under which the two-motor equipment will not give all the service required; but in heavy service in the winter conditions will occasionally be met with under which cars cannot be moved with two motors.

The second paper of the evening was presented by Mr. C. W. Ricker, the subject being "Track Bonding."

TRACK BONDING.

In classifying the various forms of rail bonds Mr. Ricker stated that while rail bonds are made in a wide variety of forms and materials, all in general use have some flexibility, for ease of application and for durability afterward, varying with the amount of flexure expected in the track structure. This has led to the general adoption of a form consisting of two terminals with a connecting shank of considerable length, to which all bonds conform, except some special kinds of very limited use, so it is convenient to classify bonds by the kind and form of contact with the rail. Contact with the rail is made in the following ways:

(1) A hole is drilled or punched in the rail and a cylindrical terminal of the bond is upset in the same way by great pressure applied slowly till the bond metal fills the hole very tightly, with the two metal surfaces in intimate contact and held there by elasticity. This is commonly called a compressed terminal and is the kind most generally used in this country. (2) A terminal of the same form is expanded in the hole in the rail by means of a drift driven through a hole in the terminal. This may be called an expanded terminal. (3) A flat terminal is soldered to the surface of the rail with either soft or brazier's solder. (4) The terminal of a copper bond and the surface or a hole in the rail are amalgamated and held in contact with slight pressure, depending upon a layer of tin amalgam to maintain the metallic contact. In one form a mass of tin amalgam to maintain the metallic contact. In one form a mass of tin amalgam is placed between amalgamated surfaces of the rail and joint plate and held in place by a cork washer squeezed between the same. (5) Copper strips or sheets are pressed against the surface of the rail by bolts designed for that purpose, or are pinched under the joint plates. (6) There are many sorts of makeshift bonds, used mainly where there is no money with which to get those of better designs: channel pins and cylindrical washers for round wires and hammer riveting are the most common. They depend mostly upon the ingenuity of the man on the work and are seldom worth consideration save when no better can be got.

To get the necessary conductivity, bonds are nearly always of copper, about the only exception being those of tin amalgam. To reduce cost and resistance, they must be as short as practicable, and the manufacturing cost must be kept low, to preserve the scrap value as near the first cost as possible. For durability they must be flexible enough so as not to break or lose contact by the allowable relative motion of the rails. They must be formed so they may be applied to the types of rails in ordinary use, in such position as to be protected from accidental damage, and from theft. They should be readily accessible for inspection and repair. The cost of application must be kept low, and to this end it is very important that the process shall be so simple and easy that no highly skilled labor or extraordinary care is required to install them with certain and uniform results. The bond that satisfies all these conditions has not yet been devised.

After dealing with the general practice in regard to the installation of bonds and the results obtained therewith, the author gives data concerning the cost of applying bonds. On a single-track interurban road the total labor cost per bond was found to be 27.5 cents, of which 5 cents was chargeable to plating and 22.5 cents to bonding. The work was continually interrupted by construction trains, and the temperature was so high that several men were overcome by heat. With clear track and decent temperature the daily output could be increased 20 per cent. at the same total cost. On a larger installation under somewhat more favorable conditions the total labor cost was about 12 cents per bond, 3 cents for plating and 9 cents for bonding.

In order to reach some general conclusions regarding the economical expenditure for bonding use is made of Kelvin's law, the assumption being made that the power costs 2 cents per kw-hour, while the cost of the material of the bonds and of applying them to the rails varies directly with the cross-sectional area. On this basis it is shown that for a single-track line with 200 amp. in the track, the bond should have an area of 223,000 circular mils. On a double-track line carrying 800 amp. the most economical size of bond is found to be 472,000 circular mils.

The discussion of the paper was participated in by Messrs. H. A. Lardner, A. A. Knudson, William Pestell and Calvert Townley. Mr. Lardner considered that some form of bond is desirable which is more readily inspected than the expanded terminal bond commonly placed underneath the splice bars. This requirement will introduce long and expensive bonds, and he believes it to be absolutely essential in some way to utilize the spliced bars themselves with short connections to the rails, which connections can be made outside and without the removal of the bolts of the spliced bars. Mr. Knudson considered that the structure of elevated railways contains such a mass of metal that the return current will not tend to be diverted to the ground to any extent. Mr. William Pestell said that the compressed or expanded terminal bond on a track exposed to

moisture and street conditions, and where the streets are paved with macadam, deteriorates more rapidly than when applied to a track on a private way where these conditions do not hold. In taking out some of the earlier type of steel terminal riveted bonds, which had been in service for 12 or 14 years, the terminals appeared to be as clean as when put in, the only corrosion being between the copper wire and the terminal. Mr. Calvert Townley considered that in calculating the capacity of bonds an electrolytic factor should enter. In a locality where there are numerous water pipes the electrolytic factor should be large, while in cross country running it may, of course, be very small. In reply to a question concerning contact resistances, Mr. Ricker said that in several cases when he had made measurements he found that it was equivalent to about one-half inch of the copper bond shank. Mr. H. A. Lardner said that the contact resistance is below anything it is possible to measure with the instruments generally available.

Electricity in England and America.

Lieut.-Colonel R. E. B. Crompton, the popular colonel of the Electrical Engineer Volunteers, gives his impression of America in the anniversary issue of the *Electrical Magazine*. The cogency of his remarks cannot fail to impress electrical engineers in this country. "I did not find that our American friends were ahead of us in any marked degree, as many English journals, technical as well as non-technical, would lead the English public to suppose. On the contrary, I found that although no doubt America could show a very large number of large installations, and consequently there is a considerably larger field for the employment of engineering talent on that side than there is over here, as regards general engineering ability, managing and organizing power, I think our English engineers were in all respects the equals of the Americans; in fact, in some respects, notably in the question of economies in the working of electrical supply systems, the severe competition by gas which prevails in this country has rendered our English central station engineers rather more efficient in these respects than the Americans. Next, as to manufacture. The Americans of course manufacture on a much larger scale than we do in this country. Their home market is of itself many times larger, but I do not think the individual organization or laying out of the electrical factories, or of similar factories where mechanical engineering of approximately the same class is being carried on, is notably, if at all, superior to the same class of factories in this country; in fact, I think the proportion of up-to-date factories here is as great as it is in America, and, conversely, the proportion of out-of-date old-time shops that still exist is as great in America as here. In fact, not a few of the shops that I had an opportunity of visiting would, if reported on by the English technical press, be said to be awful examples of old-time practice. There is one point, however, on which I think all who took part in the tour are agreed, and that is the immense superiority of the American telephone system in all their towns, to anything we have in England. The telephone in America was a delight and a luxury which one feels all the more as soon as one returns to the miseries of the London system."

Extensions to Carnegie Institute, Pittsburg.

The magnificent extensions to the above named building are rapidly nearing completion. They represent an expenditure of $5,000,000, the munificent gift of Mr. Andrew Carnegie. The new building almost obscures the original structure, which itself, a previous gift of Mr. Carnegie, cost $3,000,000. It occupies a width of 400 ft. in Forbes Street and a depth of 600 ft. In addition to the portion devoted to the library, comprised within its walls are to be found art galleries, a museum, a music hall, a lecture hall, a restaurant and the general offices required for the supervision and operation of these many divisions. The basement will be an exceptionally busy part of the building, as in addition to the modeling and casting rooms for the art department, work shops will be installed, where the repairs necessary for the maintenance of the building will be carried out. The printing office and bindery used in connection with the library, and the large lighting and heating plant necessary for illuminating and warming such a vast building are also situated in the basement.

The heating and lighting plant when completed will form a very interesting example of an installation that both in workmanship and appearance will be of very high quality, the specifications on these points being very rigid. The contract for the electric generators has been let to the National Electric Company, Milwaukee. It consists of five 300-kw, 120 r.p.m., 12-pole, 125-volt, direct-current, engine type generators. These machines will be of the latest design and best material, of massive though pleasing appearance, the heaviness in outline being relieved by the elliptical section of the frame. All visible bolts will be nickel-plated and the field coils taped on the outside and finished with a wrapping of fish net cord. The terminal boards will be of Vermont marble. The total net weight of each generator will be about 55,000 pounds, the armature and commutator accounting for 18,000 pounds. On the final test the generators will be expected to withstand a momentary overload of 75 per cent. without flashing and to operate from no load to 25 per cent. overload without shifting the brushes.

Niagara Plant of Ontario Power Co.

The contractors have practically completed the excavation of 54,000 yards of rock from the outer forebay of the intake works of the Ontario Power Company, Niagara Falls. The bulk of this work was done in the six months between July 1, 1904, and January 1, 1905. The excavated material was loaded on dump cars with a 70-ton Bucyrus rock shovel and used for grading the park in the vicinity of Dufferin Islands. The first 18-ft. Stoney gate for the headworks of the water intake has arrived and is now being assembled. This gate was made by Ransomes & Rapier, Ltd., London, and is of the same type as those used in the Assuam dam, Egypt. The motive power for operating the gate is furnished by an alternating-current motor of 5 hp, which closes the gate in about 3 minutes.

A four-motor, 40-ton, alternating-current crane, made by the Whiting Foundry Company, Harvey, Ill., has been erected complete in the distributing station. This crane of 58-ft. span was made, delivered and erected in the very short time of 75 days. Reinforced concrete will be put to a new use in the distributing station of the Ontario Power Company, Niagara Falls. A contract has been let for reinforced concrete slabs to be used as barriers in the bus-bar structures. The buses and their connectors are in compartments separated by slabs about 2 ft. wide, from 1½ in. to 4 in. in thickness, and from 3 ft. to 7 ft. in length.

CURRENT NEWS AND NOTES.

KILLED AT THE TELEPHONE.—At Detroit, Mich., on February 25, Charles Holton, aged twenty-eight, night foreman at the Woodward Avenue car house of the Detroit United Railway, sustained a fatal shock while using the railway company's private telephone line. It was evident that the telephone current had become crossed with the circuits used for operating the cars. The telephone burned for three minutes after Holton had staggered away from it and fell dead.

MARCONI'S WEDDING.—A cable dispatch from Bologna, Italy, says: "The banns for the marriage of Mr. William Marconi to Lady Beatrice O'Brien have been published at the City Hall. The religious wedding is set for March 16 at the Catholic Church of St. George, London. Lady Beatrice O'Brien brings to Mr. Marconi a dowry representing a nannual income of £4,000 ($20,000). After the wedding husband and wife will leave for New York, where they will remain until the end of April and will then come to Rome, where it is reported they will be the guests of the King for a few days."

CITY TO OPERATE EVERYTHING.—Julge Edward F. Dunne, of the Circuit Court, has been unanimously nominated for Mayor by the Democratic City Convention of Chicago. The platform declares the issue to be whether "the expressed will of our

citizens" or the "interests of a Wall Street syndicate" shall direct public policy regarding the ownership and control of the city streets for traction purposes, and demands that the people now proceed to bring about municipal ownership and operation of the street car lines. It also advocates municipal ownership and operation of gas plants, electric light plants and telephone systems.

N. E. L. A.—The Jury of Awards of the St. Louis Exposition awarded the National Electric Light Association a gold medal for its publications and its work in advancement of the electric lighting industry.

ELECTRICAL CONTRACTORS' DINNER.—The annual dinner of the Electrical Contractors' Association, of New York City, was held at the Hotel Astor on the evening of February 27, there being present about 135 members and guests. The proceedings can be best described graphically by a curve constructed from the readings of the self-registering voltmeter placed 30 in. above the floor beneath table No. 8 (the cyclone table): 7.15 p.m., 110 volts, cocktail; 7.40 p.m., 120 volts, sherry; 8.30 p.m., 145 volts, chablis; 9.15 p.m., 230 volts, champagne; 10.15 p.m., 500 volts, champagne; 11.00 p.m., 789 volts, champagne; 11.15 p.m., 999 volts, champagne; 11.16 p.m., main fuse blew.

N. E. L. A. QUESTION BOX.—The National Electric Light Association has sent out to all the electric light companies in the United States and Canada and to electrical manufacturers, engineers, dealers and technical colleges a preliminary list containing 444 questions, covering 26 headings dealing with problems encountered in the design, installation and operation of power plants, and in the generation, transmission, distribution and sale of electricity. It is expected that these questions will suggest others. Additional good live questions will be printed and sent out for answers in a subsequent and final list which is now being prepared. Due to the hearty co-operation of the members, the "Question Box" has proved to be one of the most interesting, instructive and altogether valuable features of the association.

NAVY WIRELESS.—Reports have been received by Admiral Manney, chief of the Equipment Bureau, that messages have been successfully exchanged between the United States naval wireless station at Key West and Chicago. The Key West station has also held wireless communication with steamships 150 miles east of New York. The Wey West station heard signals directly from the 15-kw station in Kansas City, Mo., on the night of February 10, and the next night it established satisfactory communication with the naval station at Cape Hatteras. Messages from Chicago were received at Key West the following week and also from Cleveland. The Key West station read messages not only from Hatteras, but from the steamships *Coamo* and *Philadelphia*, of the Red D Line, when they were within from 150 to 200 miles of New York.

INDEPENDENT TELEPHONE GROWTH.—We have received from the South a copy of a new telephone directory which has just been issued by Mr. F. C. Toepleman, general manager Home Telephone & Telegraph Company, Henderson, N. C., the contents of which are of interest as an index to the marked growth and development of the telephone business in that section of the Atlantic seaboard. The map gives an idea of how well the section has been covered with toll lines. Nearly all of the lines shown on the map were built and are owned by the Home Telephone & Telegraph Company, the total on January 1 being nearly 3,000 miles of metallic circuit. The block covers 31 exchanges, which have nearly 6,000 subscribers, which had their nucleus in an exchange of 45 subscribers built at Henderson, N. C., in the fall of 1895 by Mr. Toepleman.

REPORT ON MINING.—The Bureau of the Census has just published its final and complete report on the recent census of the mining industries of the United States. This census was conducted in collaboration with the United States Geological survey. It relates to the calendar year 1902 and forms a part of the general work of the Twelfth Census of the United States, being one of the special inquiries provided for in the legislation relating to that census. These inquiries were not to be taken up until after the main reports presenting the data collected by the enumeration of 1900 relating to population, mortality, agriculture and manufactures had been completed. A summary of the statistics relating to mines and quarries has already been presented to the public in a preliminary report published by the Bureau as a bulletin about six months ago. This was a pamphlet of 59 pages. The report now issued is a bound volume of 1,123 pages. One chapter of the report deals quite fully with the application of electricity to mining.

PARIS ELECTRIC LIGHTING COMPLICATIONS.—Following the lead of the employees of the Paris Edison Central Station, other electric lighting companies of that city are being menaced with a general strike. The labor situation, together with general complaint as to electric lighting charges, have led the municipality to take up the matter of the future status of Paris electric lighting plants. A special commission presided over by the Prefect of the Seine is also now making a study of the conditions under which the distribution of electrical energy in Paris should be ultimately controlled. The cost of electric lighting service in Paris is probably higher than in any other city in the world, the average price being twice as high as in England and still higher than in Germany. Compared with the price of gas in Paris, a given amount of illumination is stated to cost about eight times as much when furnished by electricity as when furnished by gas. This unsatisfactory condition is to be largely attributed to the fact that the franchises of the electric lighting companies will soon expire, and for some years past they have had no incentive to make expenditures tending to reduce the cost to consumers of electrical energy. Of the six companies now operating, the franchises of four will expire in April, 1907, and those of the remaining two in 1908. In the past the majority of the companies have been profitable enterprises, paying good dividends to stockholders. There has been very little power load, the lack of this being also ascribed partly to want of incentive on the part of the companies to work up a business that is soon to pass out of their hands. At present there is much discussion as to whether the municipality in taking over the plants should also operate them or lease the plants to a private operating company. Recently a foreign company narrowly escaped obtaining authorization to distribute gas in Paris, and it is stated that a large German company is now making an effort to obtain authorization for the distribution of electricity in consideration of establishing rates very much below what it would be possible to give with the present plant, however wisely and economically administered.

MUNICIPALISM IN ENGLAND.—In a recent letter to the Chicago *Chronicle* on municipal ownership in England, Mr. Robert P. Porter says: "At a meeting of the Incorporated Municipal Electrical Association, held at Sheffield on July 1, 1904, Councillor H. J. Blakeway, chairman of the electricity committee of Southampton, read a paper on the financial position of municipal electrical undertakings. He dealt with the returns of 155 municipal undertakings, the period of their work being from one to twenty years. The total capital expended amounted to $109,915,000 and the gross profit mostly for the year ended March 31, 1903, amounted to $6,655,000, or an average of 6 per cent. on the capital employed. From the gross profit, capital, charges for interest and sinking fund had to be made amounting generally to 5½ per cent. Of the 155 towns, 63 had a deficit of $356,205 and 92 a surplus of $1,344,740, or deducting the deficit from the surplus, a net profit of $988,535, equivalent to 0.9 per cent. on the capital outlay, which can be devoted to a depreciation or a renewals fund. Mr. Blakeway said that the main object of his paper was to emphasize the fact that those running municipal undertakings are under an obligation to safeguard the interests of the body of rate payers, whose credit is pledged to find the capital, but who cannot or do not all equally enjoy the benefits of the concern. In the event of losses they would be called upon to provide the deficiency. This is a very serious matter and one which should command the attention of all taxpayers before entering into this sort of speculation. As will be seen, the above facts relating to municipal electrical undertakings in England are official, and it might be worth while for the *Chronicle* to ask some of the leading business men in Chicago if they regard a net profit of less than 1 per cent. a safe margin to provide for depreciation and renewal funds and as a dividend for the investment. It does not seem to me that any municipal trader on either side of the Atlantic can point to the above with any degree of business pride."

LAND COSTS NOTHING.—The land for the proposed municipal electric lighting plant in New York City was to cost nothing, but the Board of Estimate has now appropriated $600,000 "to buy a site," etc.

THEFT OF ELECTRICITY.—A man was recently arrested in Wabash, Ind., for stealing electricity, but on account of there being no State law against the theft of electricity he could not be prosecuted. He tapped the electric light wires and was lighting his house at the electric light company's expense.

TELEPHONY IN FRANCE.—We noted recently the Webb report on poor telephonic conditions in Paris. In a recent debate in the French Chamber of Deputies the State telephone system was severely criticised. It was agreed by officials and critics that it could not compare with that in use in America, which has been developed solely by private capital.

WIRELESS TELEGRAPH AFFECTED BY TEMPERATURE.—It is stated, in a telegram from Washington, that the wireless telegraph experiments being conducted by the United States naval fleet in the West Indies have demonstrated that it is not possible to transmit wireless messages as far in the warmer zones as in the cooler northern latitudes. The experiments are to be continued.

WORCESTER POLYTECHNIC INSTITUTE.—The last annual catalogue of the Institute contains some interesting figures showing the predominating influence of electrical engineering at that school. Of the 44 students in the senior class, 22 are taking electrical engineering, the remaining 22 students being distributed among the courses of mechanical engineering, civil engineering and chemistry. Six of the eight graduate students are enrolled in electrical engineering, the other two taking general science course.

THE DOCTORS DISAGREE.—The Executive Committee of the New York Board of Trade and Transportation, in a special meeting last week at the board's rooms, instructed President William McCarroll to appoint a committee of five to take charge of the fight for a legislative investigation of telephone rates. The Merchants' Association is endeavoring to deal with the situation and with the New York Telephone Company without the "big stick," and hence there is friction between the two organizations of self-appointed busybodies.

CLEVELAND CHEAP FARES.—President Horace E. Andrews, of the Cleveland Electric Railway Company, has given out a statement addressed to the City Council covering the recent low street car fare experiments. Two weeks' trial of a three-cent fare within a two-mile limit showed a loss per day of $764 in the company's earnings, and this loss was sustained on only 18½ per cent. of the company's total fares, and for thirteen out of twenty-four hours of the day, from 6 a.m. until 7 p.m. At the expiration of the three-cent fare for a two-mile ride the company put into operation a four-cent, no limit, ride without a transfer for eight days. The result showed a loss of $1,375 per day, as compared with the company's earnings for the same service for the same number of days prior to the low-fare experiments.

NEW BRITISH CABLE.—Plans are being actively discussed for the new British Atlantic cable, in addition to the new Commercial cable. The proposed cable, which would be primarily for naval and military purposes, would be the final link in an all-British line encircling the globe. There are now 15 cables across the Atlantic, four of which are classified as British, but many of the stockholders in these four cable companies are of other nationalities. The recent redistribution of British warships, under Admiral Fisher's scheme, involves speedy and uninterrupted communication in time of war between the vessels of the "fighting fleets" and the Admiralty. It was only two years ago that England laid a cable across the Pacific, from Vancouver to Australia. This also was primarily for Imperial purposes. Its earnings, however, have exceeded the estimate. The proposed Atlantic cable, while enabling the British naval and military authorities to forward messages without dependence upon foreign agencies, would also be valuable for commercial purposes. With reduced rates it would probably prove a profitable venture financially.

POST OFFICE TELEPHONES.—Under the conditions of a ruling of the United States Post Office, published in the new *Postal Guide,* postmasters and post office employes are prohibited from answering inquiries made by telephone regarding mail matter in the office. Postal employees are not permitted to give out information concerning mail matter received or delivered except to the person to whom it is addressed or their authorized agents, and the department holds that this order cannot be strictly adhered to where answers are made to queries over the telephone, as the identity of the person making the inquiry cannot be definitely established. Persons who are in the habit of using the telephone in this way are requested to bear this new department order in mind, as it is a matter over which the postmaster has no control.

TELEPHONES VERSUS COURIER.—In the East, and Africa, the old-fashioned courier still has a vogue, but a change impends even there. Abyssinia, for example, no longer depends on fleet-footed horse and rider for messages, but has already 80 miles of telephone lines and 1,000 miles more have been planned out. A statement issued by the Italian ministry of posts, shows that the undertaking is being conducted in the face of obstacles. In some districts the posts have to be continually re-erected because, through torrential rains turning the land into soft bog, they have fallen down. In drier districts wooden posts are devoured by insects, and when they are replaced by others of iron they are carried off by the population to be converted into useful implements of husbandry. This necessitates a special police for telephonic lines, which have to be constantly patrolled.

NEW YORK TELEPHONE.—Senator Keenan has introduced at Albany a resolution providing for an investigation by a legislative committee of telephone conditions in New York. It was referred to the finance committee. The resolution says there has been complaint among the citizens of New York over alleged extortion practiced by the telephone company, and asserts that the complaints seem to be sufficiently well founded to justify the Legislature going into the matter. Senator Keenan had a tabulated statement showing the telephone rates paid in the different cities of the United States. In this statement it appears that the telephone rates are higher in New York than in any other city in the country. New York pays for 1,200 messages $111, Chicago $105, Boston $91, Philadelphia $87, Pittsburg $76, and so on down to $40 in Syracuse. If this be true, and in view of higher costs for living and everything else in New York, the local charge would appear to be very moderate. Resolutions calling for a legislative investigation of the whole subject of telephone charges and the telephone monopoly in New York City were adopted by the New York Board of Trade and Transportation at its monthly meeting last week, as noted elsewhere.

THE WATER POWER FAKE.—The promoter of wildcat schemes is always on the lookout for some new form in which to guise his allurements. His latest, says the *Iron Age,* is the fake water power development company, which takes out of insufficient or unreliable water privileges great units of power to furnish large areas with power for lighting, electric traction and manufacturing, to the great mutual advantage, on paper, of the consumers and the people who furnish the necessary capital. According to reports from various sections, this scheme has proved a most profitable one for the promoter. He can talk of the head of water, or the millions of gallons per hour, and shuffle the two with other statistical chicanery and the technicalities of hydraulic engineering until the thing seems only a question of putting in some turbine water wheels and generators and the necessary miles of wire, which, once accomplished, will soon bring great returns on the investment. There are so many genuine instances of the profitable development of water power that the investor who would get abnormal returns for his money has only to look about him to find plenty of modern cases where money has been made. The harnessing of Niagara and other great falls proves that money is to be made from utilizing the vast power that nature has put into falling water. The unscrupulous promoter sets forth this information in his well-printed prospectus. All is correct, perhaps, excepting the water privilege that is to be developed, which has something wrong about it.

WESTERN SOCIETY OF ENGINEERS.—The next meeting of the Western Society of Engineers (electrical section) will be held in the Monadnock Building, Chicago, March 10. W. T. Benallack, special agent, and the electrician of the Western Factory Insurance Association, is to address the meeting on the "Reduction of Electrical Fire Hazards."

THE NEW YORK SUBWAY is already pretty badly crowded in the rush hours, at some of the stations, and relief is needed. This is doing pretty well for a new institution. The Interborough Company has requested the Rapid Transit Board to consider the lengthening of local platforms to permit the use of eight or ten car trains instead of the five or six car trains. An unofficial estimate of the amount required to do the work puts it at $1,000,000.

VENTILATION OF REVOLVING-FIELD GENERATORS.—A patent issued February 21, 1905, to Mr. B. A. Behrend, relates to means for ventilating and cooling revolving-field generators and motors. The inventor provides ventilating spaces both in the stationary core and in the rim of the field frame. The ventilating spaces in the latter are provided solely for the purpose of giving an abundant supply of air to the spaces between the poles. The size of such ventilating spaces is not limited as in the case of field magnets and mechanical strength and sufficient area for the magnetic flux need only be considered. In the machine as constructed, the air is forced outwardly against the stationary winding and core and through the ventilating spaces therein, partly on account of the action of centrifugal force, but mainly by reason of the fact that the field magnets act as fans to drive the air outwardly.

NEW AUTOMOBILE CLUBHOUSE.—The Building Committee of the Automobile Club of America, composed of Albert R. Shattuck, Colgate Hoylt and Dr. Schuyler Skaats Wheeler, announces that the club has purchased from Bryan L. Kennelly a plot of land on the northerly side of Fifty-fourth Street, about two hundred and fifty feet west of Broadway, New York, having a frontage of one hundred and thirty-one feet and a depth of one hundred feet and five inches. The property is at present covered by private dwellings. On this site the club will at once erect its new clubhouse and garage. The land and building will cost something over half a million of dollars. The building will be of the most modern fireproof construction and it is designed to be a model structure of the kind both from the standpoint of architecture and that of mechanical utility. The location is very accessible and in a part of the city where the automobile interests are rapidly concentrating. The architect is Ernest Flagg, of New York.

TYPICAL AMERICAN WASTE.—The following report from Kansas City may be taken as typical of the waste of natural gas and other kindred bounties of nature. In Indiana, where similar waste went on, the cry now goes up for electric light and heat: "Thousands of wells are giving up this precious fuel and millions of cubic feet of it are never turned to account. On every side one sees gas burning in stores where it is not needed, and the lights going at full blast because it is cheaper to let them burn than to turn them off. To one who visits any of the gas towns southwest of Kansas City for the first time the extravagant use of natural gas appears almost criminal. Whenever it is time for the men to go to work or to quit at night, or whenever there is a fire or a public celebration of any character in the town, the whistles scream and screech, while natural gas sufficient to light a small town for 24 hours escapes and is wafted away across the prairies. Nor did the town authorities become alarmed when one day an unusually large whistle, with a blood-curdling screech that ran through an entire octave from the low to the high notes and back again, got stuck and defied all attempts to shut it off. Yet gas poured out of the valve with a roar for 15 minutes—gas enough to cook all the breakfasts served in a Kansas City hotel this morning. Men who travel in the gas belt regularly say great rivalry exists there among hotel keepers as to who can keep the most gas grates going. A story is told about one hotel keeper who wanted to get ahead of his competitors. He was enterprising and called in a plumber, whom he directed to put a pipe down each of the halls of the hotel. Then he attached open gas grates to the pipe every 20 ft, so that a guest walking down the corridor did not lose sight of an open gas fire from the moment he left his room until he reached the stairway. He let these fires burn night and day. It was cheaper to let them go than to hire a man to go around and turn them off. In some places in Southern Kansas the manufacturer gets natural gas for 3 cents per 1,000 cubic ft. Schools and public buildings are heated and lighted free of charge. In Chanute and many other towns a visitor notes that lights are kept burning all day long when they are apparently not needed. It is said that it is cheaper to keep the lights going than to hasten the destruction of the mantles used in connection with all these lights by turning them out and lighting them again."

ALTERNATING-CURRENT COMMUTATOR MOTOR.—In the ordinary repulsion motor, not only does the current in the coil short-circuited by the brush cause sparking, but it produces a counter torque tending to drive the armature in the reverse direction. In fact, if the circuit connecting the brushes be opened, the motor will show a decided tendency to travel in the opposite direction. By using wide brushes covering a large number of coils, the machine may be made to operate with fair results, the sparking, however, being practically prohibitive. Mr. Robert Lundell, according to a patent issued February 21, 1905, proposes to overcome the sparking and improve the performance of the machine by using the wide short-circuiting brushes to introduce current into the other coils not short-circuited, in such a manner that each coil, as it leaves the brush, will not be subjected to a change in the value of the current which it carries. Externally considered, the field coils are connected in series with the brushes, and the parts are so proportioned that the current introduced in series through the brushes is just equal to the transformer current in the coils under the brush. The machine is, therefore, a modified series motor, utilizing advantageously the disadvantageous features of the repulsion motor.

LAMINATED CONDUCTORS FOR ALTERNATING-CURRENT MACHINES.—In order to provide a symmetrical, continuous winding simple in construction and adapted for the rotor winding of induction and synchronous motors having a single conductor per slot, B. A. Behrend and E. C. Wright, according to a patent issued February 21, would use laminated bar windings with the end connections lying close to the periphery of the core and would form the joint so that large contact is obtained and the appearance of the conductor kept uniform. The laminated form secures the advantage of reduced eddy currents in the conductors and likewise makes them flexible. Each conductor is built up of a number of stampings of thin sheet copper. The stampings are all similar except that one-half of them are shorter at one end than the others and have an extension at the other end. These are placed together alternately, and thus form spaces at the ends to receive corresponding extensions of the conductor to which it is to be connected. The interlaced connections are riveted together and well soldered, the joint thus formed having large surface contact, and being uniform in appearance with the rest of the conductor.

ALUMINUM AS AN INSULATOR.—A novel use of the asymmetrical current-passing quality of aluminum is made in an alternating-current rectifier patented February 21, 1905, by William B. Churcher. In the usual form of aluminum rectifier both of the alternating-current terminals are placed in the cell, these acting alternately as the cathode, a third electrode forming at all times the anode. When the e.m.f. is above, say, 70 volts, a current is liable to pass directly from one alternating-current terminal to the other, thus interfering with the efficient operation of the cell. For high voltages, therefore, it is desirable to connect several cells in series. Where large volumes of current are to be rectified the electrolyte is liable to become unduly heated, and it becomes necessary to cool the electrolyte in some manner. It is obvious that if electric current-conducting material for conveying the cooling medium be immersed in several cells which are normally at a certain difference of potential, current will tend to flow through the cooling pipes from one cell to another without doing useful work. The inventor constructs the cooling pipes of aluminum. The current which tends to pass from one cell to the other by way of the cooling coils could not enter the electrolyte of the cell in which the cooling coil was acting as anode, and thus any disturbing influence from one cell is not transmitted to any of the others, while the cooling medium is free to pass through the coils and effect its purpose.

The Edison Electric Company's System in Southern California.—II.

LYTLE CREEK POWER PLANT.

THE Lytle Creek power plant of the Edison Electric Company diverts its water from the stream of Lytle Creek, another tributary of the Santa Ana River, located twelve miles northwest of the city of San Bernardino, at a point in the stream known as Millers Narrows. The diversion is made by means of a flume 759.39 ft. in length. This flume is in the nature of a double conduit, one portion being built below the surface of the wash to collect the underflow of the stream and the other on the surface for

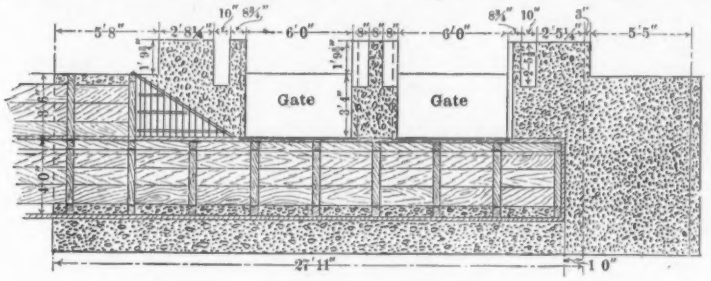


FIG. 11.—INTAKE AT LYTLE CREEK.

collecting the surface flow. Fig. 11 illustrates the design of the intake.

Across the stream has been constructed a concrete masonry dam by means of which the surface flow can be raised and turned into the upper conduit of the double flume. This dam has two 6-ft. by 4-ft. 5-in. sluice gates, which can be raised and lowered by hand with a power gear, the design being as shown in Fig. 12.

Below this intake flume is located the concrete sandbox, 30 ft.

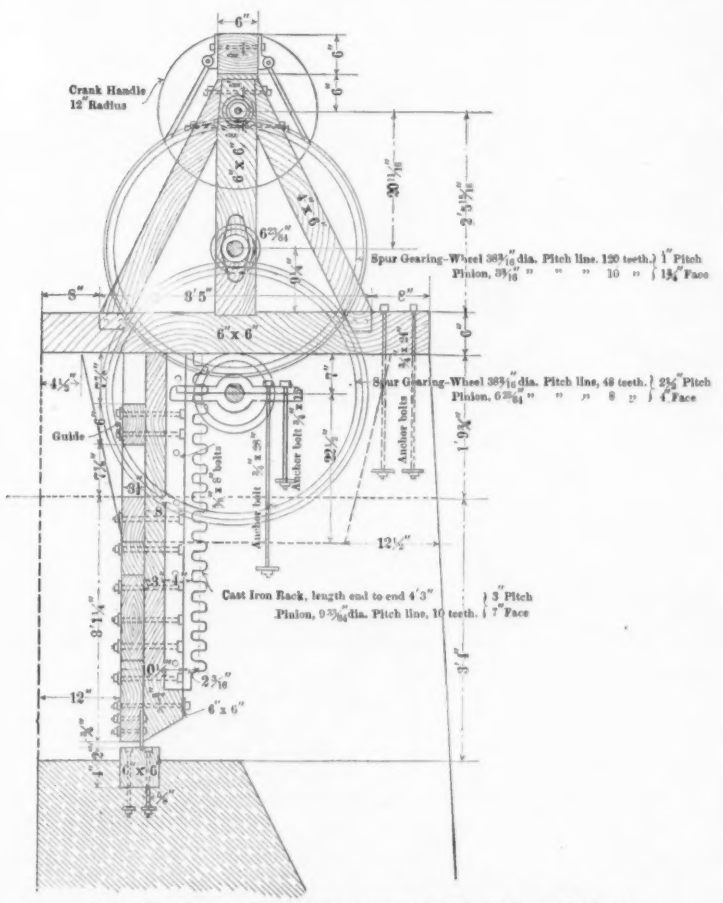

Crank Handle 12" Radius
Spur Gearing-Wheel 38 1/16" dia. Pitch line. 120 teeth. } 1" Pitch
Pinion, 3 15/16" " " " 10 " } 13/4" Face
Spur Gearing-Wheel 38 1/16" dia. Pitch line, 48 teeth. } 2 1/2" Pitch
Pinion, 6 25/64" " " " 8 " } 4" Face
Guide
Anchor bolts
Cast Iron Rack, length end to end 4'3" } 3" Pitch
Pinion, 9 35/64" dia. Pitch line, 10 teeth. } 7" Face
6"x6"

FIG. 12.—GATE AT INTAKE, LYTLE CREEK POWER PLANT.

in width by 70 ft. in length. This sandbox is of the same pattern as that already described in connection with Mill Creek No. 3, and consists of five separate chambers or sluiceways. Each of the five compartments is 30 ft. long and about 14 ft. wide, the depth varying from 3 ft. 5 in. to 8 ft. 2 in. at the lowest point. The sluiceways at the lower ends of the chambers are 24 in. in diameter. The third dividing wall from the upper end is carried up above the water line, the water flowing through a 12-ft. by 1-ft. weir into the last two chambers, from which it passes over a weir 8 ft. long and 2 ft. 2 in. deep into an 8-ft. by 20-ft. bay. The gravity conduit leads out from this bay through a 48-in. diameter opening. Fig. 13 is a view of the sandbox and flume taken after the concrete work was completed, but before the construction was entirely finished.

From the sandbox the water flows into a gravity conduit, which consists of 20,162.9 linear ft. of 36-in. inside diameter concrete pipe, 1,176.66 ft. of open rock canal, and 722.63 ft. of 36-in. inside diameter steel pipe in the form of inverted syphons. As will be observed, the greater part of the line consists of 36-in. concrete pipe, this being laid along the sides of the mountains and through all the tunnels. The rock canal referred to lies across level bench land where pipe construction is not required. It is 6 ft. wide and about 3 ft. deep. The inverted syphons are across ravines which have to be crossed under a head or high pressure of water. There are altogether 13 tunnels on the Lytle Creek plant. These are of the lengths given in the following table:

Tunnel No.	Length in feet.	Tunnel No.	Length in feet.
		1 to 7	1,422.57
1	237.20	8	234.30
2	223.80	9	276.69
3	169.20	10	177.94
4	101.60	10½	91.37
5	131.75	11	309.60
6	223.36	12	580.39
7	335.66		
	1,422.57		3,092.86

The concrete pipe of the Lytle Creek plant is laid in the same manner as described in connection with Mill Creek No. 3; the pipe

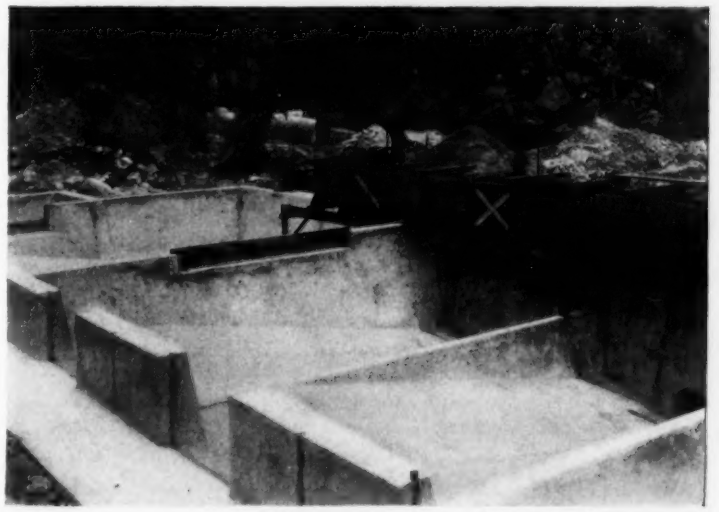


FIG. 13.—LYTLE CREEK SANDBOX AND FLUME.

itself being also manufactured by the same process and of the same class of materials. The following table gives the length of each of the inverted syphons:

No. of siphon.	Length in feet.
1	162.77
2	140.8
3	142.55
4	118.42
5	158.09
6	903.9
	1,626.53

The first five of these syphons are in the gravity line from the sandbox of the force main, while syphon No. 6 conveys the water from the tail-race of the power house to the irrigating canal of the Fontata Development Company, on the opposite side of Lytle Creek Canyon.

The steel pipe and concrete, where the two meet at connections with syphons, are joined by means of heavy concrete bulkheads, built so as to overlap the two kinds of pipe.

At the upper end of the force main is located a concrete forebay, into which the water from the concrete pipe is discharged and allowed to settle before entering the steel pipe. This forebay is of the same class as is used in connection with other plants of the company, and has ample provision for sluicing out any sediment collecting in the bottom.

The forebay is 10 ft. wide and 20 ft. long inside, with 12-in. walls, the depth varying from 5 ft. 6 in. to 10 ft. 6 in. at the lowest point,

the slope of the bottom being ¼ to 1. Water enters through a 36-in. diameter supply pipe and leaves at the side through a 30 to 26-in. reducer, 20 ft. long and connecting with the force main. (See Fig. 14.)

The force main consists of 1,513.94 linear ft. of 26 in. internal diameter, pipe of thicknesses varying from No. 12 B. W. G. to ½ in. It is constructed throughout of continuous riveted steel pipe, man-

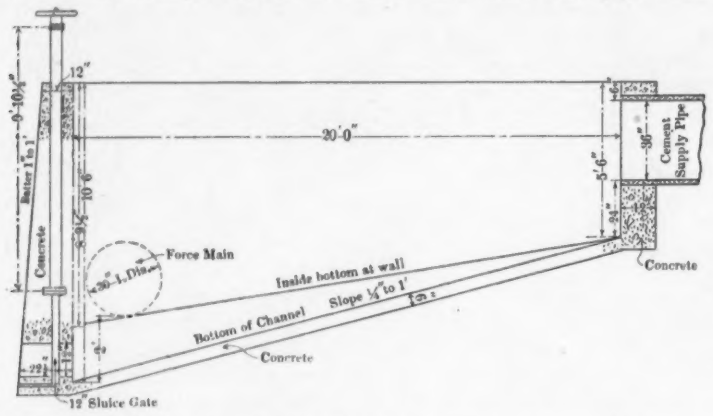


FIG. 14.—FOREBAY AT THE HEAD OF FORCE MAIN, LYTLE CREEK PLANT.

ufactured of the best grade of open-hearth steel, and coated with asphaltum. At the lower end the force main is branched by means of a cast Y into four branch pipes, of which three are 15 in. inside diameter and 45.35 ft. long. Each of these 15-in. pipes leads to one of the three 250-kw generators in the station. In addition there is an 8-in. pipe which supplies the water for the exciters. This 8-in. pipe has a length of 38.77 ft.

The waste water from the forebay at the head of the Lytle Creek force main is conducted by means of a wooden flume, similar to that carrying the waste water from the petty reservoir of the Mill Creek No. 3 plant, down to the tail-race of the plant. The surplus of water carried by the concrete conduit, therefore, flows over the spillway of the forebay and enters the waste flume, which delivers it to the tail-race at the upper end of syphon No. 6.

Another feature of the Lytle Creek plant is a small sand trap (Fig. 15), located between the section of rock canal above de-

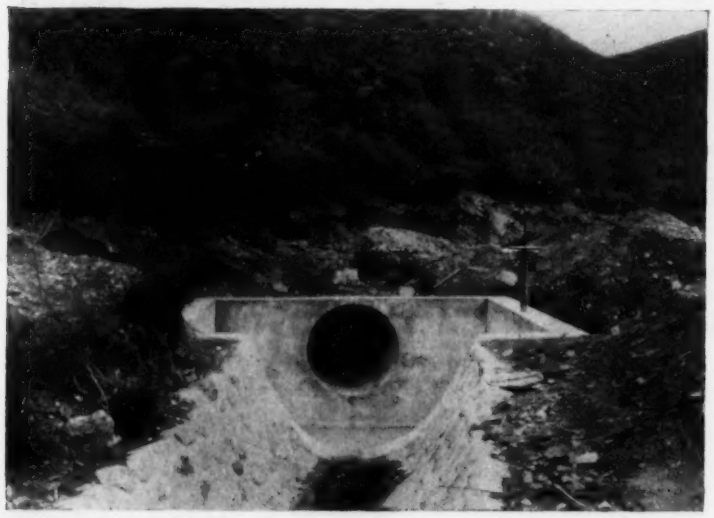


FIG. 15.—SAND TRAP BETWEEN ROCK CANAL AND CEMENT PIPE, LYTLE CREEK PLANT.

scribed, and the concrete pipe, immediately below it. This sand tray is installed for the purpose of receiving any sediment which might wash or blow into the open canal.

WATERSHED ON THE KERN RIVER.

The drainage basin of the Kern River, above the intake of the Edison Electric Company's power plant No. 1, is approximately 2,000 square miles. Its elevation ranges from about 1,000 ft. at the location of power plant No. 1 to 14,522 ft. on the summit of Mt. Whitney.

There are several high peaks at the head waters of the Kern River, whose altitude is between 13,000 and 15,000 ft., the principal ones being:

Mt. Whitney	14,522 feet
Mt. Tyndall	14,101 feet
Sheep Mountain	14,059 feet
Junction Peak	13,916 feet
Table Mountain	13,625 feet
Cirque Peak	12,941 feet

POWER PLANTS LOCATED ON THE KERN RIVER.

The length of the Kern River from the mouth of the canyon, which is less than two miles below power house No. 1 of the Edison Electric Company, to the uppermost intake of the Edison Electric Company, that of its power plant No. 6, is approximately 160 miles. The distances and amounts of fall in the stream for each of the proposed power plants throughout this 160 miles are as follows:

Name of Power Plant.	Length of stream diverted.		Total fall of length so diverted.
Power, Transit & Light Co., of Bakersfield, Cal.	2	miles	236 feet
Power Plant No. 1 of the Edison Electric Co.	12.5	miles	939 feet
Power Plant No. 2 of the Edison Electric Co.	15	miles	409 feet
Kern River Company's Plant	15	miles	263 feet
Power Plant No. 3, Edison Electric Co.	20	miles	856 feet
Power Plant No. 4, Edison Electric Co.	30	miles	1042 feet
Power Plant No. 5, Edison Electric Co.	35	miles	1322 feet
Power Plant No. 6, Edison Electric Co.	30.5	miles	1000 feet
	160	miles	6067 feet

Before giving the summary of the result to be obtained from the plants to be developed by the Edison Electric Company, reference will be made to the other plants on the river; one, that of the

FIG. 16.—PLANT AT MOUTH OF KERN RIVER CANYON.

Power, Transit & Light Company, already completed and in operation, and the other, that of the Kern River Company, now in course of construction.

The former of these, illustrated in Fig. 16, has a net fall for power purposes of 206 ft., and a length of conduit equal to about 1¾ miles, all of which is tunnel. The water supply for this plant is the same as that for power plants Nos. 1 and 2 of the Edison Company, as it is located on the main stream of the Kern River near the mouth of the canyon. The minimum flow is approximately 200 second-feet, and the capacity of the conduit is about 400 second-feet. There is now machinery installed for approximately 2,000 hp, which is not quite sufficient to utilize all of the flow at the minimum stage of the river. This power, transmitted in the form of 10,000-volt, 50-cycle, three-phase current, is being distributed in Bakersfield and its vicinity and used for lighting, the operation of electric railways, pumping water for irrigation and domestic purposes, and for a great many other commercial and industrial objects in that locality. Some of the features of this plant have been described in the ELECTRICAL WORLD AND ENGINEER of April 6, 1901.

The Kern River Company's plant will have a net fall from the forebay to the power house floor of about 227 ft., and a gross fall of 251 ft., the 24 ft. difference being utilized by means of draught tubes. This plant does not obtain the entire flow of Kern River at its maximum point, since it diverts from the North Fork above

the junction with the South Fork of the river. The line of this power conduit is approximately 12.65 miles long, and consists principally of open earth canal, there being some flumes and tunnels. Based upon the amount of water in the stream, the output of this plant will be, at times of minimum flow, about 2,000 hp, and during times of maximum flow about 8,000 hp. The Kern River Company is allied with the Pacific Light & Power Company, of Los Angeles, and the power will be transmitted to that city and be utilized principally by the Huntington railway systems. The 125-mile double pole line is completed.

The following table gives the data relating to the six power plants which are proposed to be constructed by the Edison Electric Company on Kern River:

No. of plant.	Net head in feet.	Minimum flow at intake, in sec. feet.	Capacity of conduit proposed in sec. feet.	Minimum H.P. to be developed.	No. of H.P. with capacity of conduit full.
1	872	200	400	16,000	32,000
2	317	200	400	5,800	11,600
3	760	240	400	16,800	28,000
3	910	240	400	20,000	33,370
5	1,158	160	300	17,000	31.800
6	880	150	300	12,096	24,192
				87,696	160,962

These figures are interesting as they show that the Edison Electric Company owns the water rights and has plans more or less defined for a minimum development of 87,696 hp on the Kern River, while the full capacity of the plants, which could be obtained during the entire year with the exception of a few weeks between August and October, will be over 160,000 hp. Added to that of the present and prospective plants in San Bernardino and Los Angeles Counties, the ultimate generating capacity of the company's plants, including one steam station, is found to be 185,000 hp. It may be a generation or more before there will arise a demand for any such vast amount of power, but when the demand does come the company will be prepared to meet it. It is probable that work will be gradually carried on on all of the Kern River plants, but even the most optimistic will not look for the completion of the work inside of 20 years. At present the company is engaged in constructing plant No. 1 and merely building roads and trails to the sites of other plants. As the construction work of the No. 1 plant is somewhat unusual and, on the whole, of decided interest detailed mention will be made of it.

GENERAL SCHEME OF KERN RIVER PLANT NO. 1.

The general plan being worked out for Kern River plant No. 1 includes the diversion of the water about 15 miles from the mouth of the canyon by means of a concrete dam, carrying it down a gravity conduit consisting almost entirely of a series of tunnels to a small forebay and dropping it through an inclined pressure tunnel to the power house, which will be located on solid bedrock on the south bank of the river, and directly opposite the intake tunnel of the Power, Transit & Light Company's plant. The total length of the gravity conduit will be about 8.8 miles, a saving of about four miles in the length of the stream. The expense of driving the tunnels will be considerable, but the company feels that for the handling of such a large amount of water it is fully justified in putting in this style of construction which of course will be permanent and subject to practically no depreciation losses and little cost for maintenance. On the gravity conduit there will be 19 tunnels, only very short flumes being used between tunnels in crossing ravines. As these flumes will probably be covered, or will consist of pipes, the entire conduit will be enclosed and there will be practically no evaporation loss. Since the evaporation from the natural stream of the Kern River is estimated to be fully 15 or 20 per cent., during the summer months when the water is low, this factor is an important one during periods of minimum flow and one that will also be duly appreciated by the irrigators who take the water after it leaves the mouth of the canyon. Another advantage in the closed conduit is that no leaves, sticks or other débris can enter it after the water leaves the headworks.

DESCRIPTION OF HEADWORKS AND TUNNELS.

The diverting dam at the head of the conduit line will be constructed in concrete and the natural granite, and will be about 20 ft. high and 100 ft. long. It will span the stream at that point and back up the water for a distance of about 1¼ miles. The necessity for a special sandbox at this point will be eliminated, as the reservoir back of the dam will serve for the deposit of all silt and sediment, the water being taken out at the top of the dam. For the sluicing of the reservoir there is being constructed a special tunnel 365 ft. in length, which is located below the level of the foundation of the dam. This drainage tunnel will drain the reservoir at a point some distance above the intake tunnel and will discharge into the river below the dam.

An important feature of this drainage tunnel will be a hydraulically-operated gate. The gate will be 9 ft. wide and 9 ft. high, the size of the tunnel section, and will be built up horizontally of eight 12-in. I-beams, weighing 40 pounds per foot, strengthened vertically by 4-in. by 5-in. T-irons, weighing 12 pounds per foot. The whole will be supported by two 15-in. vertical I-beams, weighing 60 pounds per foot. The gate operates in cast-iron guides, rolling at each side over four bronze rollers 3½ in. in diameter and 3 in. long. There will be two hydraulic cylinders, each 11 ft. 9½ in. long over all and with a bare inside diameter of 32 in., the lining being of brass 3/16 in. thick. The cylinders are built for 200 pounds pressure and will be operated by means of a four-way bronze valve connected with the cylinder ends by 2½-in. extra strong wrought-iron pipe. The piston rods will be 6 in. in diameter and 30 ft. 7½ in. long and will be constructed of bronze or wrought-iron sheathed with ⅛-in. brass. They operate through a shaft 40 ft. high and 9 ft. square on the inside and are built of concrete with 3-ft. walls.

The water for the gravity conduit will be taken from the dam through regulating gates and enter a 595-ft. tunnel known as tunnel

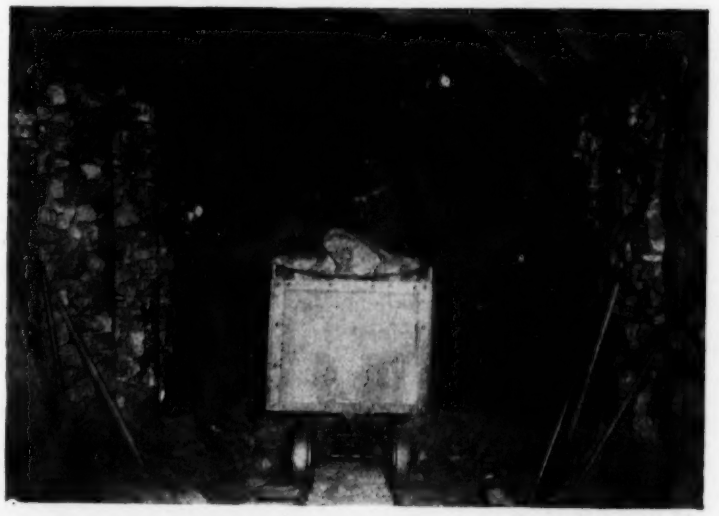


FIG. 17.—TIMBERED SECTION OF TUNNEL NO. 19, KERN RIVER.

No. 1. Between tunnels No. 1 and No. 2 will be a 1,180-ft. flume, by far the longest on the system, the others varying from 42 to 260 ft. in length. As a safeguard, a sandbox will probably be constructed at the lower end of this flume. The lengths of the 21 tunnels, including the drainage tunnel and the one for the force main, are given in the following table:

Drainage Tunnel	365 feet	Tunnel No. 11	2587 feet
Tunnel No. 1	595 feet	Tunnel No. 12	2170 feet
Tunnel No. 2	3150 feet	Tunnel No. 13	2335 feet
Tunnel No. 3	4049 feet	Tunnel No. 14	4374 feet
Tunnel No. 4	406 feet	Tunnel No. 15	3767 feet
Tunnel No. 5	1522 feet	Tunnel No. 16	1499 feet
Tunnel No. 6	1805 feet	Tunnel No. 17	1898 feet
Tunnel No. 7	825 feet	Tunnel No. 18	2134 feet
Tunnel No. 8	3842 feet	Tunnel No. 19	751 feet
Tunnel No. 9	2070 feet	Tunnel No. 20	1700 feet
Tunnel No. 10	3011 feet		
		Total length	44,945 feet

The total length of tunnels is thus seen to be 44,945 ft., and about one-half of this distance has been excavated. This work has been carried on in all of the tunnels and some of them are nearly completed. The reason for dividing the tunnel work up into a number of sections was because of the greater convenience of making the excavations. On each of the 20 gravity tunnels the work is being carried on from both ends and on the pressure tunnel from the lower end, so the entire work is divided among 41 headings. The number of openings will also be an advantage in patrolling the conduit after it is completed. The tunnels are carried in as near a straight line as was practicable, being brought to the surface in crossing short ravines or by means of short adits. Where necessary to span the

ravines between tunnels there will be used solid constructions consisting either of steel flumes built on stone and concrete or steel piers, or the entire work will be done in concrete. The total drop in the gravity line is 66.5 ft., or about 7½ ft. to the mile. The tunnels are being excavated to a width of 9 ft. and to a height of about 9 ft., as near as the nature of the material will allow. Each section will have 3 or 4 in. of concrete on the bottom and will be lined to a height of 7 ft. In places where the roof of the tunnel will not stand up it will be concreted over. In one or two of the tunnels, especially in No. 19, considerable timbering has been necessary, and in those cases there is used a standard bent formed of 6-in. by 8-in. timber, the bents being placed about 4 ft. 6 in. apart, as shown in Fig. 17, which illustrates the timbering in the lower end of Tunnel No. 19. The timbers for one bent are packed on a single mule for transportation to the point where they are needed. When completed the timbered sections will be entirely covered with concrete, the timbers being left in position. Fig. 18 shows sections of the tunnel con-

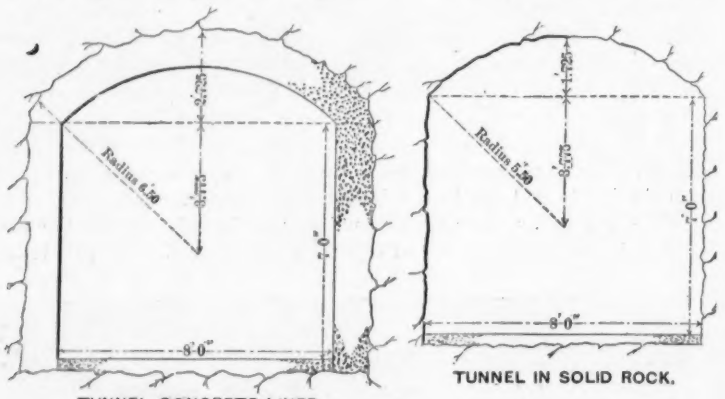


FIG. 18.—CROSS SECTION OF TUNNELS FOR KERN RIVER PLANT NO. 1.

crete lined and in solid rock. Probably not more than 1 per cent. of the entire length of tunnels will have to be timbered.

PRESSURE MAIN TUNNEL AND POWER HOUSE.

The lower end of Tunnel No. 19 is at the top of a spur of Mt. Breckenridge overlooking the power house site. Here an open forebay will probably be constructed by concreting in an artificial basin. From this forebay the pressure tunnel will be carried down at about an angle of 30° with the horizontal until it strikes a horizontal tunnel that has its lower opening at the power house site on the end of the river. This horizontal section, about 400 ft. in length, has been completed and work is now progressing on the inclined tunnel. To construct the latter a small shaft about 3 ft. in diameter is being driven from the horizontal section to the top. When this is completed, work on the full size, 9 ft. by 9 ft. tunnel will be started at the top and carried downward, the small shaft being used to carry off the excavated material. When the tunnel is completed a steel pipe of sufficient size and strength to carry the full 400 second-feet of the gravity conduit will be laid in the tunnel and securely packed with concrete on all sides. The pipe will be dipped in asphaltum and having the concrete and rock wall outside to equalize the pressure within should stand indefinitely, and even if it should rust out the concrete shaft will carry the water. The net head to be derived from the pressure pipe will be 872 ft., which will give 32,000 hp with 400 second-feet of water. The mouth of the horizontal portion of the pressure tunnel is illustrated in Fig. 19, which shows the formation of the bank at that point. At the lower left-hand corner of the latter view may be seen the natural bedrock upon which the masonry or solid concrete power house will be built. The foundation walls of the building will be of concrete and are to be carried up high enough to raise the station floor above high water mark. The dump from the tunnel is shown in Fig. 19, and above, on a level bench, are located an engineer's brick cottage, one of the permanent buildings, the compressor house and other buildings of Camp No. 1. Fig. 19 shows also at the top of the mountain the shears supporting the end of the aerial cable by which materials are hoisted to the level of the gravity conduit.

CONSTRUCTION WORK.

The prosecution of the work on the Kern River has been fraught with many difficulties. When the Edison Company began its work there was no road in the canyon and only an occasional trail. About the first work done consisted in building a good substantial road along the south side of the river from the mouth of the canyon to the power house site of Camp No. 1. The cost of building this road was considerable, since much of it had to be blasted out of the walls of the canyon and a good deal of filling had to be done. The grade is about 2 per cent., and all sharp turns had to be avoided, as supplies and materials are hauled to the camp by six and eight-horse teams, which can pull only on easy curves. At the beginning all supplies were hauled from Bakersfield, about 22 miles from Camp No. 1. Arrangements were made later with the Southern Pacific Railroad for a switch track at a point seven miles south of Bakersfield and a large storehouse was built there, the station being named "Edison." This forms the base of supplies for all the Kern River work of the Edison Company. It is in charge of a storekeeper, who is in telephonic communication with the camps on the river, Bakersfield and the main offices of the company in Los Angeles. The storekeeper also acts as timekeeper and cashier for the men employed in the canyon. The haul from Edison to Camp

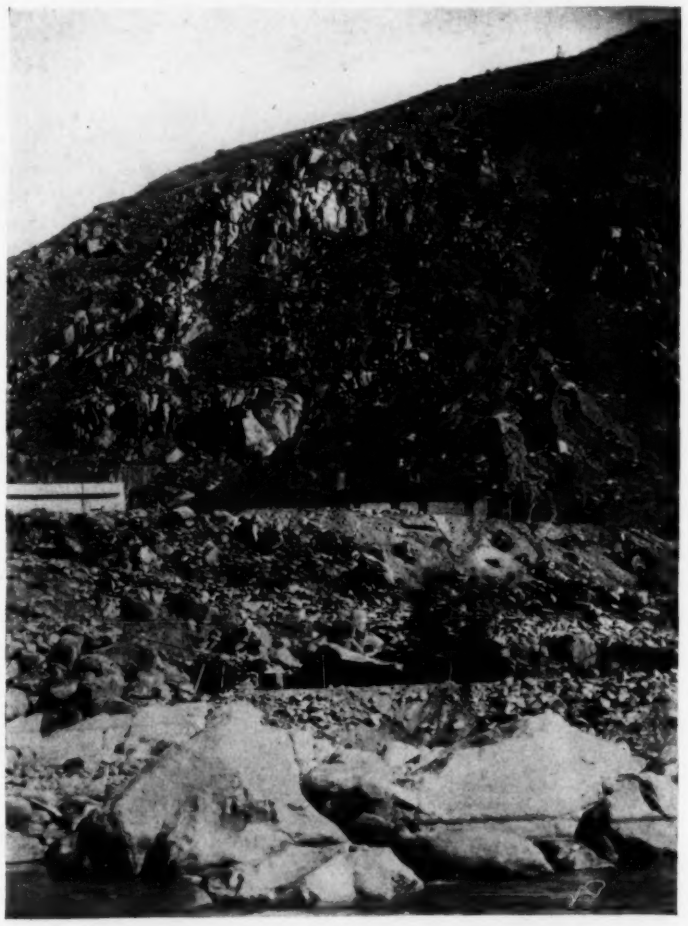


FIG. 19.—POWER-HOUSE SITE OF KERN RIVER, NO. 1, SHOWING MOUTH OF PRESSURE TUNNEL.

No. 1 is about 17 miles, a saving of five miles thus being effected over the Bakersfield haul. Six working camps have been located on the main river between the power house site and the intake. These camps are designated in order of location upstream as No. 1, No. 5, No. 2, No. 3, No. 4 and No. 6. Camp No. 5 is usually known as Frenchtown. Before these camps were located a trail had to be built following in general the grade of the tunnels. As most of the camps were located on the river bed, branch trails had to be constructed from the main one. All materials and supplies for the camps above No. 1 have to be packed on mules and burros and carried over these trails. These difficulties of transportation have naturally hindered the otherwise rapid advancement of the work.

CONSTRUCTION OF POWER PLANT.

Excavation in the tunnels was done by hand drilling at first, but this method has now given place in most of the headings to air drilling, the electric power for driving the air compressors being derived from a construction power plant installed last year. This plant is located near the Frenchtown camp, where a natural fall in the river of about 40 ft. has been utilized. The flume which carries the water to the station is built of redwood timber and is

10 ft. wide and 5 ft. deep. The intake for the flume, Fig. 20, has a 20-ft. opening at the upper end, and contracts to the 10-ft. width in a distance of 32 ft. The headgate for the flume is 10 ft. wide and is raised by a double rack through hand cranks and gearing at the sides, the pinions being mounted on a 5-in. shaft.

The station building is 26 ft. wide and 58 ft. long, and is built of corrugated iron, as shown in Fig. 20. The section, Fig. 21, shows

FIG. 20.—CONSTRUCTION POWER PLANT AND FLUMES.

the design of the station. The two 250-hp turbine wheels are of the McCormick type and were manufactured by the S. Morgan Smith Company, of York, Pa. Each operates at 600 revolutions

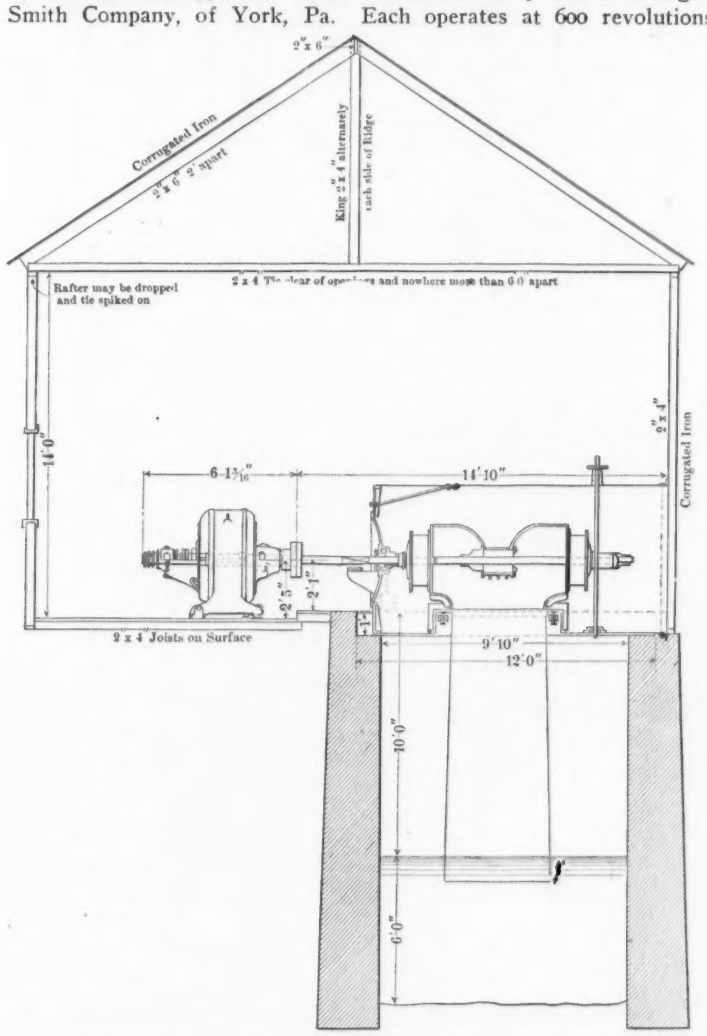


FIG. 21.—SECTION OF POWER HOUSE FOR CONSTRUCTION PLANT ON KERN RIVER, NO. 1.

under a 50-ft. head, 10 ft. of which is taken up by the draft tube. Each wheel is direct-connected to a 150-kw, 2,300-volt, three-phase, 60-cycle General Electric alternator, and one wheel, in addition to its generator, drives by means of a belt a J. Hendy air compressor, the capacity of which is 600 cu. ft. of free air per minute. The rest of the equipment of the station includes three 75-kw transformers for raising the machine voltage to that of the transmission line, 10,000 volts, and a two-panel switchboard upon which are mounted the necessary switches and instruments.

Power is transmitted four miles down the canyon to Camp No. 1 at the generator voltage, 2,300 volts, and there used to drive three motors. The largest of these is 50 hp and is belted to a Compressed Air & Machinery Company's 400 cu. ft. compressor. A 5-hp motor operates the tools in the machine shop, which at present consist of two machine lathes and a drill press. This shop's equipment seems almost too modern to be found so far from civilization, but it is a permanent installation and is now used continually for the repair of drills, etc. The third motor at this camp is used to drive a Fulton Engine Works hoist operating a 1,800-ft. cable. The motor is of 30 hp.

Power is transmitted up the canyon from the construction power plant to Camps Nos. 2, 3 and 4, the length of the 10,000-volt line being 11 miles. At each of these camps the e.m.f. is stepped down to 2,300 volts, the power being used for driving air compressors. At Camp 2 there are two 75-hp motors driving compressors similar to the one at the Frenchtown construction station; at Camp 3 a 50-hp motor is used, and at Camp 4 a single 75-hp motor. At Camp No. 3 a 2,800-ft Fulton hoist is directly driven by a 20-hp motor.

Another use to which the electric power is put is in operating pumps. At the Camp 2 compressor house, two triplex pumps driven by 3-hp motors are installed for raising, from the river 500 ft. below, the water needed for cooling the cylinders of the compressors. At Camp 3 one triplex pump similarly driven is used to raise water 350 ft. for a like purpose. At Camps 1 and 4 water is raised 100 ft. by means of steam pumps, which are operated by air furnished from the compressors after they start up.

Electric motors in 1 and 2-hp sizes are also used to drive ventilating blowers at the entrance to the longer tunnels. Mention of these will be made later. Not the least important use of the construction plant is the supplying of current for lighting the tunnels. camps, compressor houses, etc.

The Outlook for Electrical Engineers.

BY HOWARD S. KNOWLTON.

IT seems to have become very much the fashion of late among some of the engineers who have had the privilege of addressing large bodies of students in our technical schools to throw cold water in no small quantities upon the prospects of young engineers in general and electrical engineers in particular. A great deal has been said about overcrowded conditions; the systematizing of modern industry to a degree which leaves little opportunity for the inexperienced graduate to be worth even the modest $6 a week which strives to live up to itself as a salary; the concentration of epoch-making responsibilities in a few expert hands, or rather heads; the uselessness of preparing to specialize in any particular department when six to one the newly hatched graduate will find himself collecting bills, filing correspondence or counting kegs of nails and checking up the arrival of sundry cans of oil, grease, barrels of lamps, etc., where he had expected to be designing new and wondrous types of bridges, lighting circuits, dynamos and transmission lines, and finally the development of applied science to such a point that there is little chance for the exercise of even exceptional intellectual power in the way of new discoveries. If one of the speakers happens to be particularly optimistic, he will perhaps throw in that rather indigestible crumb of comfort, "There's always room at the top," and go his way with a sense of duty done in trying to sensibly check the ultra-enthusiasm of ambitious youth.

A little serious consideration of this point of view is all that is necessary to demonstrate its error. In the first place, enthusiasm is one of the most vital factors in the world's progress, and anyone who attempts to destroy it runs the risk of stifling that originality of view which is the foundation of every real advance in engineering. The hard-bought experiences of business life are usually rough enough to at least dull the edge of that fresh vitality which is perhaps the most striking characteristic of the young engineer's personality. Experience will temper enthusiasm where a wet blanket lecture will anneal it.

It is, of course, well for both students and newly developed engineers to realize what has been accomplished in the past before they attempt to improve upon the present. Probably more men are going into engineering work to-day than ever before. Whether this is due to the widespread increase in the facilities for obtaining scientific education or to the more general recognition of the function of engineering in modern civilized life, the fact remains that close competition exists and will probably grow keener rather than less severe as time goes on. It is also true that the general principles which underlie the practice of electrical engineering have become well established. The discovery of a new and important law in electrical science is a rare occurrence at the present time. Putting these facts together, it may be true that overcrowding exists among those who would devote their lives to purely technical pursuits, but with the commercial problems of twentieth century engineering which are in crying need of solution staring us in the face, it is preposterous to sit down and fold our hands with the idea that nothing worth doing remains.

Theories rise and fall, and systems come and go, but the day is far distant when the keen edge of original thought based upon sound training cannot hew out a secure place for itself in the most hide-bound and red-taped corporation which ever employs new blood. Strong as the tendency of the times is toward the organization of great enterprises which may be operated by wage earners rather than by a salaried rank and file, there never is likely to be a time when the direction and analysis of the working of these great industrial forces will not require the services of trained business engineers. While it may be given to the few to originate the broad conceptions which link their names in history to the larger industrial undertakings, it is given to every subordinate to do his own detailed work so well and so ably that it shall have its part in the final success of the completed structure, and the stimulus of being identified with even a small part of an important undertaking is no mean one.

Considering the man who has specially trained himself for service in some particular field of electrical work, it is hard to see wherein the probable early experiences of his business life should debar him from such preparation. One's perspective undergoes a tremendous change after the prized diploma is framed and hung, or else, alas! stowed away in a trunk against a time of use which seldom arrives. There are those who hold that it makes little difference where the engineering graduate first gets his grip on practical affairs, so long as he gets the grip. However this may be, it is certain that a special knowledge of one field is often of great value, particularly in electrical work, which touches every phase of civilized activity. Inasmuch as it is frequently impossible to predict the field of work which a man will follow through circumstances and choice, there would seem to be no reason why any special predilections should not be indulged. The lists of graduates published in the catalogues of engineering schools illustrate occupations ranging from engineers and managers to poets and milkmen!

Every branch of engineering has its unsolved problems to-day, and particularly does this apply to electrical work. Transatlantic telephony is still to be realized, and on land, New York and Denver remain to be connected by toll lines. Innumerable water powers the world over await the development which the presence of a market sets in motion. The storage battery has far from captured the automobile for long-distance travel. The telegraph still does a duplex and quadruplex business instead of a multiplex transmission. Railway signalling is capable of being greatly improved, particularly on trolley roads. The power house bristles with differences of opinion as to apparatus and systems advisable and the sub-station stands at the threshold of great changes in design. The production of electrical energy direct from coal challenges the ablest minds of modern times. Wireless telegraphy, the electrification of steam railway suburban service and the development of certain interurban lines with alternating-current motors stand as open doors of opportunity to the electrical engineer. Industrial chemistry calls for electrical assistance as never before. The freight traffic of steam railways still remains loyal to the steam locomotive and challenges the best electrical engineers of the transportation field to capture it.

Finally, the operation of all the electrical enterprises thus far developed opens a permanent field for the abilities of innumerable engineers. The growing appreciation of the business side of technical work is one of the brightest signs of the times. Opportunities for eliminating waste and misdirected labor are never wanting. If every branch of electrical science were applied to the capacity of civilization to receive its application, there would still remain the great field of operation as a promising outlook for electrical engineers.

An Italian Electrical Laboratory.

BY GUIDO SEMENZA.

AT the recent International Electrical Congress an interesting paper was read on "Insulating Materials in High-Tension Cables," by Mr. Emanuel Jona, chief electrician of the India rubber and cable works of Messrs. Pirelli & Co., in Milan, Italy. In that paper certain views, quite novel, were set forth on the distribution of dielectric stresses and some applications of the same to cable manufacture were described. As it may be of interest to readers to learn of the electrical laboratory where Mr. Jona works and to know something of what he is doing, the following description is given:

The scope of the laboratory is to test all materials which are employed in the different departments of the works, to test cables, wires and all other electrotechnical products before delivery, and to investigate matters relating to insulation.

Fig. 1 shows a plan of the laboratory. A room, marked on the plan with the letter *B*, is reserved for all kinds of low-tension

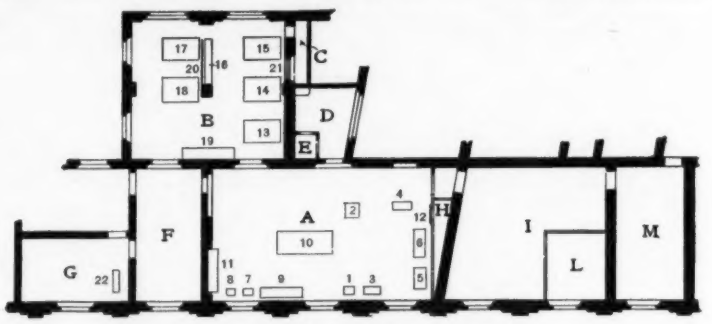


FIG. 1.—PLAN VIEW OF LABORATORY.

tests, and another, marked on the plan with the letter *A*, for high-tension alternating-current tests. In the low-tension testing room there are six tables, each for a different kind of research.

Table 13 carries two Thomson galvanometers with standard rheostat boxes, keys and all the necessary accessories for insulation and capacity tests. Twelve well insulated lines lead from this table to the different parts of the works, thus greatly extending the range of the laboratory and facilitating the work of testing.

One of the galvanometer sets works by means of Leclanché cells up to a maximum e.m.f. of 300 volts, while the other can be worked by a storage battery of 2,000 small elements, with a capacity of 1.5 amp.-hours, up to an e.m.f. of 4,000 volts. Of course, special care had to be taken to protect the operators from such high tension; keys and other parts intended to be handled by the operators are enclosed in glass boxes and provided with long ebonite handles.

Table 14 carries two sets for localizing faults in small wires, in wires of large section or in cables. In every case a Wheatstone bridge system with Thomson galvanometer is employed, the cable under test forming two of the legs of the bridge separated by the fault. The two sets differ only in the nature of the rheostat used. In the case of cables of large section, the connecting wires form part of the rheostat (a calibrated wire) so that any error due to leads can be avoided.

Table 15 and table 14 are used principally for testing the resistivity of the copper wire employed in the manufacture of insulated conductors, and the resistance of the finished cables, for which purpose table 15 carries a Wheatstone bridge set, comprising an Elliot quadrant bridge and a Sullivan reflecting galvanometer and a Thomson double bridge with a Rowland reflecting galvanometer. Tables 17 and 18 are used for special investigations.

The laboratory has also a complete assortment of galvanometers, rheostats, electrometers, condensers, etc., thus supplying facilities for many kinds of special tests and for experimental work.

It is to be remarked that not a single piece of wire or cable, the insulation of which has to be water-proof, leaves the factory without having been first tested in water. Lead-covered cables are also tested in water, experience having shown that it is not safe to assume a lead tube always water-proof. Paper-insulated telephone

cables undergo a special test. The ends of the lead tube being rendered air-tight, air is forced into it at a pressure of 36 pounds to the square inch, a pressure gauge being used to ascertain that there is no air leakage.

The room intended for high-tension alternating-current tests, marked *A* on the plan (Fig. 1), and shown in part in Fig. 2, contains among other things a most complete collection of potential transformers, as follows: A 10-kw single-phase transformer for voltages up to 12,000; one of 12 kw for voltages up to 60,000; a 12-kw, three-phase transformer for voltages up to 12,000; a 40-kw, single-phase transformer for voltages up to 3,000; a 50-kw, three-phase transformer for voltages up to 65,000; a 50-kw, single-phase transformer for voltages up to 200,000.

All these transformers are fed from a 160-volt, three-phase circuit of the Milan Edison Company, the frequency being 42. The high-tension circuit is divided in two or three sections in order to connect them in parallel or in series as required.

The transformers were constructed in Pirelli & Co.'s works from the designs and under supervision of Mr. Jona. They are provided with a number of switches, rheostats and instruments for the regulation of the testing potential.

The high-tension measurements are always made by means of electrometers, the spark-through or air-gap system being considered to be unreliable. The form of wave has in fact a great influence on the disruptive distance and one cannot tell how the capacity of the tested object alters the wave form. Then the shape of the electrodes and their wear may influence the discharge.

Up to 50,000 volts Mr. Jona uses a Thomson electrostatic voltmeter, but as there was not to be found on the market a reliable instrument for higher potentials, he was compelled to construct one for his own use. Fig. 5 is a diagrammatic representation of a 200,000-volt Jona electrometer. *A* and *B* are the terminals of the instrument to be connected to the poles of the transformer. The instrument measures the attraction between a movable plate, *P*, which hangs from a suspension, *S*, by means of a metallic thread connected with the top terminal of the instrument, and a fixed plate. The whole instrument is contained in a glass box, *V*, filled with paraffine oil. The bottom of the glass box is metallized both internally and externally, and the terminal, *A*, is solid with the external bottom portion of the box. Through electric induction the internal metal lining receives an electric charge, which acts on the movable plate, *P*, and attracts it. *C* is a cylindrical metallic protection at the same potential as *P*.

The scale of the instrument is graduated to read in kilovolts.

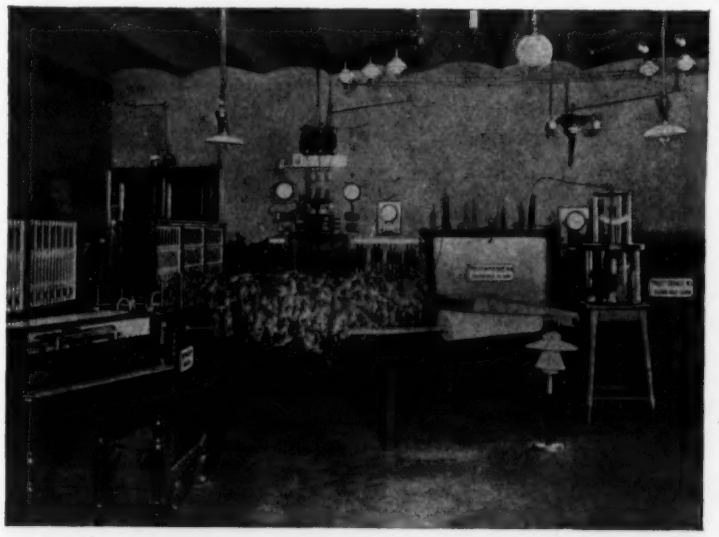


FIG. 2.—HIGH-TENSION ROOM.

The change of one of the weights on the suspension, *S*, alters the value of the scale, which may vary for every division, and have a value equivalent to 1,000, 750, 500, 250 volts, according to the weight. The instrument is carried on a wooden stand, *T*, which keeps the terminal insulated. The height of the scale is such that it faces the eye of the observer. All high-tension parts are immersed in vaseline oil, which acts as an insulator and a damper. These instruments are remarkable for their sensitiveness and accuracy, are quite convenient and occupy a small space.

The 200,000-volt transformer is used only for tests carried on in the laboratory, as the distribution of such a potential over the works would not be advisable. The 65,000-volt current is transmitted by means of underground cables to the room where the water tanks for the testing of cables are installed, the transmission cables being about 100 meters long.

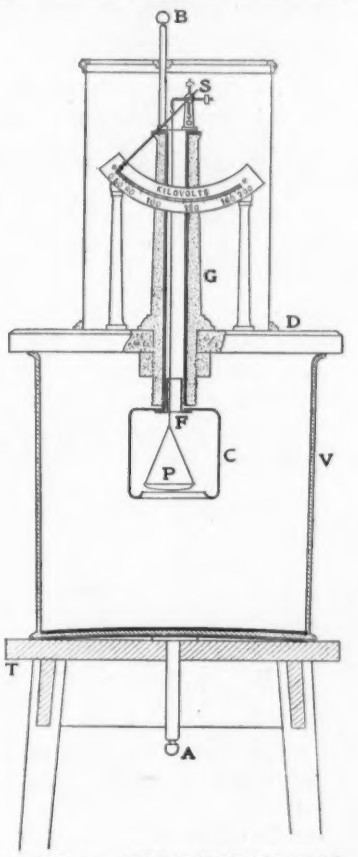


FIG. 3.—200,000-VOLT ELECTROMETER.

An interesting apparatus is a lamp table fitted up to show customers that during the test the tension is actually supplied to the cables. For such purpose a sufficient number of lamps in series are lit to make up the testing voltage. On the table are arranged 800 110-volt lamps and the voltage can consequently be carried to 90,000. The table is specially insulated and each lamp is provided with a special shunt in case it should burn out. A thin silk-covered wire (*A B*, Fig. 4), bridges over the two leads of a lamp. Should the lamp burn out the silk is punctured and the current passes immediately from one wire to the other, thus shunting the lamp.

There is in the works a special installation for the electrical burning out of faults in cables or in insulated wires. Instead of localizing a fault by electrical measurement, which method, on account of the high resistance offered, requires a long time and is often unreliable, it is preferable to immerse the insulated wires in water and apply high tension between the wire and the water or between the cable and the lead cover, gradually raising it until the fault is burned out.

Mr. Jona, in his Congress paper, gave a description of a cable for 50,000 volts, which had been tested up to 100,000 volts without being perforated. This cable, represented full size in Fig. 5, is insulated internally with several layers of India rubber of different quality, and externally with impregnated paper, the process having been patented by the firm of Pirelli & Co. in March, 1900. In this way is obtained a better separation of the tension in the thickness of the insulating material, besides the advantage of a concentration of the India rubber insulation in the internal portions, where the greater dielectric strength of the India rubber is properly utilized. The principle has been thoroughly described by Mr. Jona in his paper, in which he has shown the method to calculate the distribution of the potential in the thickness of a dielectric cable with homogeneous and also with hererogeneous insulation, both for round and for irregular cables.

It is not necessary to repeat here the exposition of these principles, and I shall only mention that the cable above named is nothing else but a conductive stranded spiral of 162 sq. mm. section, placed in a lead pipe in order to make it perfectly round, the final diameter being 18 mm. It is insulated first with a layer of rubber 2 mm. thick, having a specific inductive capacity of 6.1; then with a second and a third layer of rubber 2.3 and 4.5 mm. thick respectively, of 4.7 and 4.2 specific inductive capacity. On the rubber there is a layer of impregnated paper 5.2 mm. thick, having a specific inductive capacity of 4. The cable is then lead-covered, the total thickness of insulation being 14.5 mm. At 50,000 volts the maximum strain in the first layer of rubber is 4,400 volts and at the paper 3,250 volts per mm. With a homogeneous dielectric the maximum strain would be 5,800 volts.

The test at which the writer was present consisted in an effort to puncture the insulation of the cable, and as at the end of four hours under a potential of 100,000 volts no result had been obtained, it was decided to raise the voltage until the burning of the cable was secured.

The greatest difficulty experienced in this test was in avoiding surface discharges at the ends of the cable, due to the fact that if a potential of 100,000 volts disrupts an air space of 25 mm., the same will run over a rubber surface of nearly one meter, from which results the necessity of protecting the ends of the cables in some way; Mr. Jona adopted for this purpose a coating of paraffine. The end of the cable, from which the lead covering had been taken off for the length of one meter, was fitted with a conical mould which was then filled with melted pure paraffine. Once the paraffine had solidified, the mould was removed and the end of the cable presented

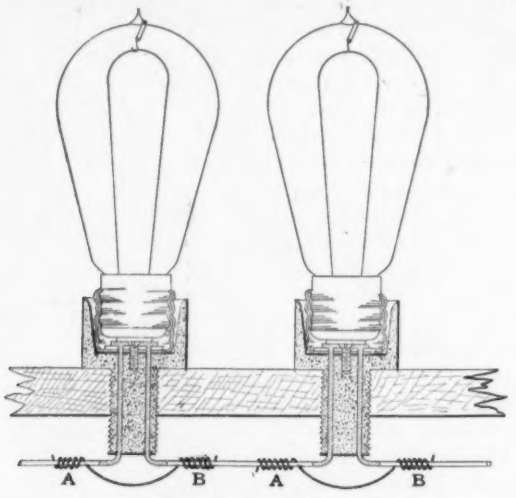


FIG. 4.—SHUNT FOR INCANDESCENT LAMPS.

the appearance of a block of paraffine. Fig. 2 shows at the left the coil of cable during the experiment and also the two paraffine coverings employed in the test; at the right is shown the voltmeter used for the direct measurement of the testing potential.

The operation was repeated several times. At the first operation a disruptive discharge passed between the paraffine and the rubber at 120,000 volts; at the second it passed at 130,000 volts and at the third at 150,000 volts. As it was then not possible to make a coating which would stand a higher potential, the test was given up at 150,000 volts without damage to the cable, which proves the possibility of a 50,000-volt cable. The above refers to the case of a single cable. Three similar cables put together for a three-phase

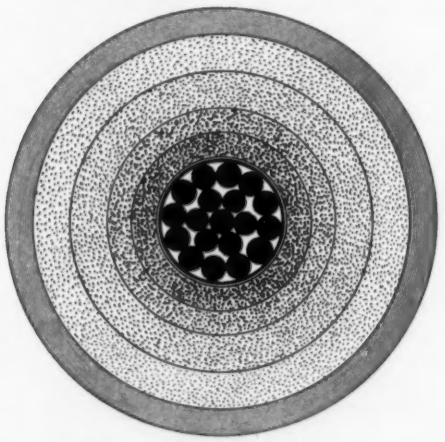


FIG. 5.—50,000-VOLT CABLE.

circuit (star connected), could consequently transmit a current under a tension of 80,000 volts.

At present Mr. Jona is investigating the dielectric hysteresis losses in the dielectrics employed in the manufacture of cables for high tension. He measures these losses by means of a special voltmeter, which serves also as an electro-dynamometer. This instrument has been expressly constructed by the Tecnomasio Italiano in Milan. It is constructed on the principle of the attraction of a stationary coil (series) in a movable coil (shunt.)

The special form of the windings and their construction details are such as to give in the instrument a very great sensibility and a scale graduation almost uniform. A current of 0.04 amp. in the movable coil and one of 0.03 amp. in the stationary one, are sufficient to give a deflection over the entire scale, which is 135 mm. long; and the regularity of the graduation allows the reading of a deviation corresponding to 0.001 amp. in the stationary coil. A great metallic non-inductive resistance, capable of being graduated beyond one megohm, inserted in series with the stationary coil, allows the instrument to be employed for very high tensions. When a higher sensibility is required, a reflecting instrument of the same kind is used.

Testing of Direct-Connected Generators.

By George T. Hanchett.

DIRECT-CONNECTED generators are commercially tested for two purposes. One is to determine their commercial efficiency and the other their ability to carry the load for which they are rated.

Included in the efficiency tests is the separation of the various losses of the machine, and a host of individual methods for doing this at once becomes available to the engineer. Most of these methods are interesting only to the manufacturer, for it is his place to apportion the various losses in selecting the design. The buyer of the apparatus is not interested as to where the losses exist provided that they do not reach an unduly large gross total, and that no part of the machine suffers by reason of too great a concentration of loss in any one part, and provided further that the regulation of the machine is not thereby disturbed.

The load test is important both to the builder and the user of the apparatus. This involves running the machine at full load and noting its behavior and regulation, and the testing of the insulation resistance.

It is intended to devote this article to the tests in which the user of the apparatus is interested, for to include in its scope the many interesting manufacturers' tests would require a volume rather than a few columns. In order to cover the ground with any reasonable degree of thoroughness, it will be limited to the consideration of direct-current, direct-connected machinery.

LOAD OR PERFORMANCE TEST.

This is the test most commonly made by the consulting engineer or contractor to determine whether the machinery has reached its guarantee of performance. The measurements are entirely electrical and thermal. For this work will be required an accurately calibrated ammeter and voltmeter of suitable range. The latter should have a low reading scale. It will also be desirable to have a means for measuring resistance, and it is almost indispensable to have an outside source of potential. An ohmmeter or bridge will suffice for measuring the high resistance and the ammeter and low-reading voltmeter will answer excellently for measuring those that are low. Two or more thermometers graduated to degrees and having a scale from 70° to 200° F. will also be desirable. In addition to this a millivoltmeter is essential, and if the ammeter consists of a shunt and millivoltmeter, as is often the case, the instrument can be made to serve two purposes.

If no load can be secured for the generator, one must be provided which can best be made up in the form of water rheostats, preferably made of barrels. One barrel of water will comfortably carry a load of 20 kw without undue boiling, and an appropriate number should be selected and connected in multiple for the purpose. A convenient form for arranging this resistance is shown in Fig. 1. A plate of an area equal as nearly as may be to the head of the barrel is bolted to the bottom by a single bolt, with rubber washers, and to this the wire may be connected from without by means of the bolt protruding from the bottom of the barrel, which should be mounted on two short skids clear of the floor. The other terminal should be a heavy piece of iron connected to a piece of flexible cable and equipped with means whereby it can be lowered and raised in the liquid that the barrel contains. A hitching weight will be found to answer excellently. The current-carrying cable should not be depended upon to raise and lower the weight. A stout piece of trolley cord passing over a pulley and fastened to a block will be found convenient.

The way in which a performance test should be conducted may best be illustrated by a practical example. Let us suppose that, being equipped as above specified, it is required to test a 100-kw, direct-connected, 240-volt generator. No less than five barrels should be provided and connected in parallel to the main switch on the board. The weights should be adjusted so that they are ready to be let down in the liquid, but do not touch.

Attention should then be turned to the generator, and the resist-

ance of its various circuits should be measured, the temperature of the room being noted at the same time. The resistance of the shunt field coil can be best measured with an ohmmeter or bridge, as its resistance will be from 25 to 30 ohms. The resistance of the armature, however, cannot be measured in this way, as its value is very low. To do this an outside source of current should be used. The circuit can be opened and the main switch connecting the water resistance to the generator closed. The field circuit should be open also, and an outside source of current should be applied to the armature circuit at the break provided. The water resistances should all be lowered until their plates touch the surface of the liquid, and a small current will flow through the armature circuit. A low-resistance voltmeter should then be applied to the commutator bars, upon which brushes of opposite polarity rest, and the current should be increased until there appears a deflection covering at least one-half of the scale of the instrument, and the resistance should then be computed by Ohm's law. It is essential to select the bars of the commutator instead of the brush holders, as the resistance of the brush contacts and the brushes themselves is a considerable percentage of the armature resistance. If the series coil is included in the circuit, as it should be, the resistance of this can also be taken by the same fall of potential method, and at the same time.

These three resistances of the shunt, the series coil and the armature circuit should be reduced to ohms and recorded in the notes as the resistances at the temperature of the engine room. No further preliminary measurements will be necessary before starting the machine, for it is not fair to the manufacturer to take an insulation resistance test at this time, for the machine is usually set up in a basement and has been standing there for some time waiting to be started, and has undoubtedly accumulated dampness, which will disappear after running.

The next step is to open the load circuit, close the broken circuits and cause the machine to build up to its operating voltage, where it should be allowed to run for a period of half an hour, advantage being taken of the interval to adjust the brushes and examine the bearings of the engine and dynamo, so as to be sure that no acci-

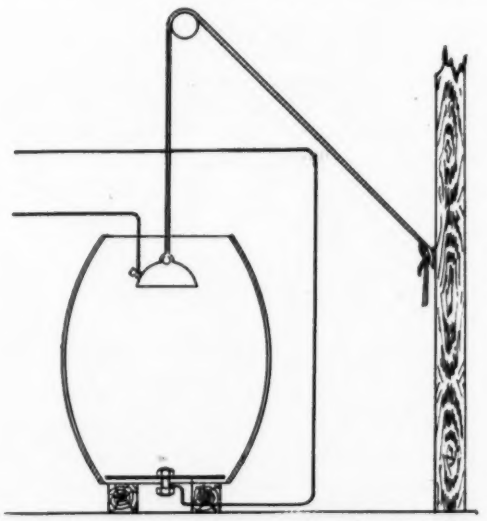


FIG. 1.—DIAGRAM OF WATER RESISTANCE OUTFIT.

dent of overheating will interrupt the test. The field coils will also be given an opportunity to warm up. As soon as it is plain that the engine and generator are in condition to receive load and carry it for a period of time, the main switch may be closed and the water resistance adjusted until the upper plates are submerged, but remain near the top of the barrels. If ordinary tap water is used the load will hardly be perceptible, a few amperes at most. It may now be increased by the addition of strong brine to the barrels, adding an equal amount to each, until the machine has developed about one-quarter load, in this case about 110 amp. It is much better to use strong brine instead of powdered salt in adjusting the barrels to this condition. If salt is used it will take time for the salt to dissolve, and the manipulator is apt to put in too much salt, and, upon the subsequent dissolving of the excess, he will find the resistance so low in value that it will be unmanageable. The brine, however, thoroughly mingles with the contents of the barrels and quickly brings the solution to a uniform condition.

The load may now be increased to the rated full capacity of the machine, and under these conditions the machine should operate for at least two hours before any attempt is made to determine its performance. If the brushes have to be advanced to secure sparkless running, the amount of advance should be noted and marked upon the brush holder ring, but if the machine is of modern construction it is likely that little if any advance of the brushes will be necessary. The purpose of this long full-load run is to allow the machine to acquire what is known as commercial conditions, that is, the tem-

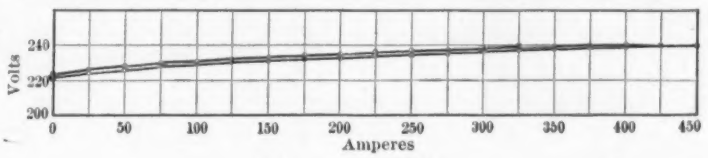


FIG. 2.—LOAD CURVE.

perature of all parts must be raised to the maximum that they will acquire under full-load conditions.

After two hours have elapsed, the regulation of the machine may be tested as follows:

The rheostat should be adjusted to give the full load potential of the machine, and if resistance in the rheostat is cut in for this purpose a reasonable time should elapse until the rheostat coils have had opportunity to warm up, for the change in their resistance has an influence on the regulation. As soon as constant conditions have been reached, the engine speed and machine potential should be carefully noted and then the load should be abruptly thrown off. The engine speed should then again be noted, and if it has risen it should be reduced by the throttle until it is the same as underload. The change of speed is, of course, chargeable entirely to the engine, and the generator should not be required to regulate for engine speed variation. If it is found difficult to reduce the engine speed a few revolutions by means of the throttle, and this will usually be the case, a judicious use of the throttle and cylinder cocks will usually produce the desired result. As soon as the speed has become constant and restored to the rated speed in this way, the voltmeter potential should again be observed and should now indicate the no-load voltage at which the dynamo is rated. Full throttle should then be restored, the cylinder cocks closed, and the load quickly applied, and as soon as the engine has settled to rated speed again, the voltmeter should indicate full-load voltage once more. This will probably not be strictly true, for a field magnet is bound to have a certain hysteretic effect, and while there will be produced magnetism and, therefore, potential, dependent upon the ampere-turns, the magnetism and potential is also affected by the previous treatment that the machine has received.

Ampere-turns and speed conditions being equal, difference of operating potential under conditions otherwise identical can be charged to this cause, but it should not exceed 1 per cent. of the total voltage of the machine. This effect can be very prettily developed by gradually reducing the load to zero by steps and taking the voltage at every step, and then increasing the load to full value again also by steps, and with similar measurements. The results can be plotted with potentials as ordinates and loads as abscissæ and will form a loop of which Fig. 2 is a typical case. When the engine is under full throttle, the speed, of course, is not under control except as determined by the governor, and at all of these observations the speed should be kept constant. As it will be impossible to adjust the speed, it should be noted and the observed voltages corrected by dividing by the observed speed and multiplying by the rated speed.

By the time these tests are completed, the machine will have run at least three hours, and will be thoroughly warmed up. It should then be stopped and the resistance tests at once repeated and the results recorded in the notes as the hot resistances of the dynamo. Thermometers should be placed on the field coil, armature and commutator, and it will be best to have three thermometers so that the readings may be made simultaneously. The thermometer should be laid in a convenient position on the armature and covered with a pad of waste. Another thermometer should be laid on the commutator next the brushes and securely covered. This is likely to be the hottest part of the machine and should be carefully compared to limiting temperatures allowed in the specifications. The thermometer should be allowed to remain in this position one-half an hour before being read, as the machine will become hotter after it has remained at rest for a short period, because the outer surfaces are relatively cooler by reason of the rotation, and will be warmed up by heat from the inside. The temperature rise, expressed in

degrees Centigrade, can also be obtained by means of the following formula:

$$R_T = Rt\ (1 + .004\ \Theta).$$

In this formula R is the resistance at room temperature and Rt the resistance hot. Θ is the temperature elevation $(T - t)$, in Centigrade degrees. The values of the observed temperature and the temperature obtained by resistance will not check, that obtained by resistance being the higher and more accurate of the two. If the machine is underloaded, an approximate idea of the overload as per its rating that it is capable of carrying for an indefinite period can be computed from these temperature observations.

The specifications provided by the American Institute of Electrical Engineers for the performance of direct-current dynamos prescribe the following temperature increases:

Field and armature by resistance method, 50° C.

Commutator and brushes, by thermometer, 55° C.

If these are exceeded the machine may be considered as overrated, and if they are not the machine may be considered as underrated; the latter is usually the case.

Increased load upon the generator will result in increased copper losses in the armature, but the other losses will remain substantially the same. In modern generators it is common to make the armature iron and copper losses at full load approximately equal unless the machine is of a special type, and they may be assumed to be so for the purpose of rough calculations. The copper losses in the armature are computed in watts by squaring the full-load current and multiplying by the hot resistance of the armature. Doubling this amount gives approximately the total armature losses, and dividing this value by the rise in temperature gives the watts radiated per degree. If, therefore, the temperature of the armature is found to be, for instance 10° lower than the American Institute specifications, the armature may be assumed to be capable of radiating a proportionately greater number of watts, and multiplying this figure by the watts per degree, we can obtain the additional copper losses which will be permissible. If this is divided by the resistance and the square root of the result taken, a figure will be reached which will represent roughly the additional current load that the generator can carry without exceeding the specifications of the American Institute. This method is very approximate, and can be much more accurately applied, when the losses due to other causes than I²R are more accurately known as shown beyond. There are other conditions which limit the load of the generator which are not computable, such as commutator troubles and the like.

The generator should now be subjected to a test for insulation resistance, and the best test to apply is to submit the insulation to an outside potential in series with a voltmeter of known resistance and compute by the well-known method of voltage drop. For a 220-volt machine the resistance should exceed 1 megohm. If it is found to be less, the voltmeter should be kept in circuit and the various parts of the machine disconnected one after another until the source of leak makes itself evident by its disappearance. If the leakage and insulation is general, appearing in the ratio of about two-thirds in the armature and one-third in the fields, or in ratios roughly similar, it is not unlikely that the conditions will improve as the machine becomes more used. If, however, almost all of the leakages are found in the armature or field, a local defect can be inferred. If in the field, the process of subdividing by separating the field coils should be employed, and if it is found to reside almost entirely in one bobbin, the bobbin should be thoroughly investigated, and it will probably be necessary to call in the manufacturer. A measurable leak of any magnitude found in the rocker arms or terminal blocks should not be tolerated in any event, as it indicates a local defect which may become serious.

In many cases it is not necessary to make an efficiency test on a direct-current generator. If any of the standard makes are bought and the unit is not a large one, the manufacturers' guarantee is usually accepted, and it is generally safe to do this, as direct-current dynamo design has reached a state of perfection such that efficiency at any load can be accurately predicted.

In important installations where the units are large, or in cases where the machine has betrayed serious losses by undue temperature rises, it may be desirable to make an efficiency test. As stated in the first paragraph of this article, the commercial efficiency of the machine is all that interests the buyer, provided that the losses do not reach too great a total and are distributed in such a way on the machine as not to injure it.

Of the many methods of testing direct-current, direct-connected machines, these two have been found convenient. One is the indicator method by which the mechanical input is measured by an indicator on the engine cylinder, and the electrical output is measured by instruments. This is not altogether satisfactory, because of the errors of the indicator and the complication of the result by reason of the friction of the engine. If an outside source of current is available, it is much better to employ what is known as the loss method, or stray power test.

The performance test as outlined above contains much data of value in making a generator test by the stray-power method. The connecting rod of the engine is disconnected, the shunt field of the generator is excited from an outside source, and a measured current is applied to the armature, which is then driven as a motor under no load, and the field and armature voltage are adjusted until rated speed is reached at rated armature pressure. The series coil, if there is one, should be omitted in this test, the voltage being applied directly to the armature terminals, due care, of course, being observed to increase it gradually, preferably through the same water resistance which has served as a load in the performance test.

The observations which should then be made are as follows:

No. 1, speed.

No. 2, impressed electromotive force on the armature.

No. 3, current used in driving the armature as a motor.

No. 4, hot resistance of armature and series coils.

No. 5, hot resistance of shunt field circuit, including such portion of the rheostat as is used in practical running.

From these results the efficiency of the dynamo at any load can be computed, and if the instruments are accurate and their errors known, a precision of 1 per cent. can reasonably be expected.

In explanation of the stray-power method of testing it is well to itemize and describe the various losses of the machine. They are distributed as follows:

1, bearings.

2, brush friction and windage.

3, hysteresis.

4, eddy currents.

5, I^2R losses in the armature and series circuits.

6, I^2R losses in the fields.

In the stray-power method of testing, the I^2R losses are always calculable at any given load, provided the resistance of the various circuits of the machine is known. The remaining loss, grouped together in a gross total, is known as the stray-power, and as it is impossible exactly to reproduce conditions of speed and armature voltage, it is always assumed that the stray power varies proportionately with each.

It will probably be clearer to apply this method directly to the testing of the 100-kw machine that we have already taken as an example.

Assume that the measurements above indicated are recorded as follows:

Speed, 253 r.p.m.

Impressed e.m.f. on the armature, 240 volts.

Current used in driving the armature as a motor, 23 amp.

Hot resistance of armature only, .0115 ohm.

Hot resistance of armature and series field coils, .01735 ohm.

Hot resistance of shunt field circuit, including such portion of the rheostat as is used in practical running, 28.8 ohms.

The watts applied to the armature in this case are:

$$23 \times 240 = 5{,}520\ watts.$$

This comprises the stray power of the machine when operating as a motor, and the armature I^2R losses which in this case equal

$$23^2 \times .0115 = 6.08\ watts,$$

and the net stray power of the armature under these conditions equal

$$5{,}520 - 6.08 = 5{,}513.92\ watts.$$

The armature voltage of the machine operating as a motor is equal to the impressed e.m.f. on the armature minus the IR drop in the machine. The value of the latter is

$$23 \times .0115 = .264\ volts,$$

and the armature voltage is, therefore,

$$240 - .264 = 239.736.$$

We are now ready to compute the efficiency of the machine at any desired speed or load. The most interesting value is usually the full-load voltage, and this will be computed as a typical case. Assume that the full-load conditions are as follows:

Voltage, 250.
Current, 420.
Speed, 250.

The true armature voltage of the machine under full-load conditions is equal to the voltage given above *plus* the armature drop. The armature circuit drop is $(420 + 8.3) \times .01735 = 7.43$ volts, 8.3 amp. being the shunt field current, and the full-load armature voltage is $250 + 7.43 = 257.43$. If we take the stray power value already obtained, 5,514 watts, and divide it by the product of speed and armature voltage during the stray-power test and multiply the result by the product of speed and armature voltage under full-load conditions, we shall have the first item of loss in the machine. This, as shown below, is equal to 5,851 watts:

$$\frac{5{,}514 \times 250 \times 257.43}{253 \times 239.73} = 5851$$

To this value must be added three other items, the I^2R loss in the armature, the I^2R loss in the series field coil, and the I^2R loss in the shunt field coil.

The I^2R loss in the armature = $428.3^2 \times .0115 = 2110$ *watts.*
The I^2R loss in the series field coil = $428.3^2 \times .00585 = 1073$ *watts.*
The I^2R loss in the shunt field coil = $250 \times 83.3 = 2082$ *watts.*
The stray power = 5851 *watts.*

Total losses of the machine at full load are, therefore, = 11,116 *watts.*

The output of the machine at full load is 105,000 watts.
The input of the machine is the sum of the output and the losses, and is equal to 105,000 + 11,116 = 116,116 watts.

The efficiency is $\frac{105{,}000}{116{,}116} = 90.4$ per cent.

The efficiency of the machine is the output divided by the input. This, it will be seen at once, can be determined for any speed and load.

The errors of the method are not large, but it is interesting to consider their nature. There is some discussion among engineers as to whether the friction of the engine bearings is properly chargeable to the dynamo, and it is certainly included in the stray-power measurement made by the above method. It is contended by some that if the dynamo were not a direct-connected machine, bearings must be provided, and in a machine of this size there would undoubtedly be three bearings, an outboard bearing being provided on the pulley side, and it is, therefore, proper to charge the machine with the friction of three bearings. This, however, gives the engine an undue efficiency. It is usually considered that the engine is applied to the dynamo and not the dynamo to the engine, and as the dynamo under test cannot possibly be operated without proper bearings, and, moreover, as it is impossible to conduct the test otherwise than has been done, there seem to be very potent reasons for including the friction of the bearings in the test. The stray-power losses are not absolutely proportional to the speed and to the armature voltage. The bearing friction is theoretically proportional to the speed, provided the pressure on the bearings is constant. Unfortunately, this is not absolutely true. The hysteretic loss is proportional directly to the speed and can be properly corrected in the manner indicated. The eddy-current losses are proportional to the square of the armature voltage and to the square of the speed, and if both the armature voltage and speed corrections are applied, this error is further enhanced. The hysteretic loss, which is proportional to 1.6 power of the armature voltage, according to the method, is considered to be directly proportional thereto. These corrections for change of speed are fortunately very small if the test has been properly conducted.

In conducting the test, great care should be taken that the conditions are identical with the conditions that obtain under load. The machine should be fully warmed up by a previous load running, the brush tension should be the same, and the speed under load should, as far as possible, be reproduced.

A Line Repair Job In South Africa.

In South Africa the use of electric power in mining is probably more advanced than in any other portion of the world, notwithstanding the fact that the conditions are such as to require the greatest reliability in the delivery of power to pumps in order to keep a mine from being flooded. As a consequence of this latter consideration, an accident in a generating station or to a line is a very serious matter, and creates an emergency that calls for the exercise of the greatest resource in expedients. An example is offered in an accident to one of the lines of the Consolidated Gold Fields Company of South Africa, Limited, which occurred last November, and to which the accompanying illustration, taken after a temporary repair had been made, refers.

On the evening of November 18, during a very heavy rainstorm, every fuse in the station blew, and it was soon found that three of the feeders were damaged. As one of these feeders was the main line to the Knights Deep Mine, which takes water very rapidly, and where the pumping is entirely dependent upon the supply of current, the emergency was a critical one, and a search party was immediately dispatched, which found that ten poles of the main line were down. The poles are of standard English telephone construction, consisting of a tapered iron top set into a cast-iron base. The trouble originated at a guyed corner pole, a drainage ditch in the neighborhood having overflowed and washed out the guy connection, the strain on the line pulled the pole over, breaking it off at the cast-iron base, and other poles on each side followed suit. The end pole left standing on one side was bent, but did not go over, and in the other direction a pole which was heavily guyed swayed to one side, but was able to hold up under the lessened tension on the lines.

TEMPORARY LINE WORK.

As soon as the extent of the accident was discovered a neighboring timber yard was raided and a supply of planks commandeered, which were hastily knocked into three-legged tripods, as shown in the illustration. Cross arms were then spiked to these and some drums of underwriters' wire, which fortunately happened to be in the neighborhood, were rolled into position and a line run out and connected to the existing line. Notwithstanding that a heavy rain was falling all the while, the line was completed and current switched on at 5 o'clock in the morning. It was then found that a short-circuit still existed, which, upon investigation, was discovered to be due to the lines having twisted together farther back, owing to the slacking off when the break occurred. This was soon straightened out and the Knights Deep pumps were running at 6 o'clock, after a shutdown of about eight hours. This temporary line was used for about a week. Although some of the lower levels of the mine were flooded, the service was resumed in time to prevent any of the pumps being submerged. It happens that the pumps are so situated that if the lower power station gets flooded, the level of the water will be such that all the pumps will be submerged and rendered useless.

Mr. A. W. K. Peirce, formerly of New York, is consulting electrical engineer to the Consolidated Gold Fields Company of South Africa. The above work was carried out by his brother, who is in direct charge of the plant.

The Meter-Testing Board of the Detroit Edison Company.

Although some electric light companies are more or less negligent in the matter of meter testing, the fact is generally acknowledged that the money expended in the care of meters by periodic testing and inspection always gives good returns. The Detroit Edison Company, recognizing this, has installed a well-arranged switchboard with auxiliary apparatus for making station tests of customers' meters. The board with the auxiliaries is well shown in the accompanying diagram and photographs. Low potential current is used in the current coils of the meters under test. This, while decreasing the actual loss in watts, also does away with cumbersome lamp banks. The whole system is supplied from 2,300-volt alternating current mains. Three 5-kw transformers reduce the potential to 230 volts. From the secondary of these transformers, one set of mains supplies a 10-hp induction motor generating set. Another set of leads is carried to two ½-kw step down transformers, which further reduce the potential to 5 volts, for testing the current coils of large alternating-current meters. The direct current from the two generators of the motor generator sets is carried through ammeters and to the middle connections of the double-pole, double-throw switches shown at the extreme left of the diagram, Fig. 1. The upper connections of these switches are connected through the neutral wire to the carbon rheostats of the test boards, and to the two upper bus-bars of a plugboard. The lower terminals are so connected as to place the two motor-generator sets in series when the switches are thrown down. Between the central connection of the remaining double-pole double-throw switches of the switchboard proper are connected the storage batteries. The upper terminals of these switches are also connected to bus-bars of the plugboards and to the neutral wire. By a study of the diagram, it will be seen that, with all switches up, current is led direct from the storage battery to the upper bus-bars of the plugboard and from the motor-generator set to the middle bus-bars of this plugboard. With all the switches down, the two generators are connected in series with the two sections of the storage battery.

The terminals of the low potential transformers are likewise brought to a pair of bus-bars of the plugboard and to the neutral wire. Current for the shunt coils, both alternating and direct, is supplied to the testboards through individual, double-pole, double-throw switches immediately below the plug board. The direct-current connections from the motor-generator set are carried to the upper terminals of the switches, and leads from the two 230-volt transformers supply the lower connections. The testboards are connected to the middle terminals. By this arrangement either alternating or direct current may be supplied to the testboards, depending on whether the switches are in the up or the down position.

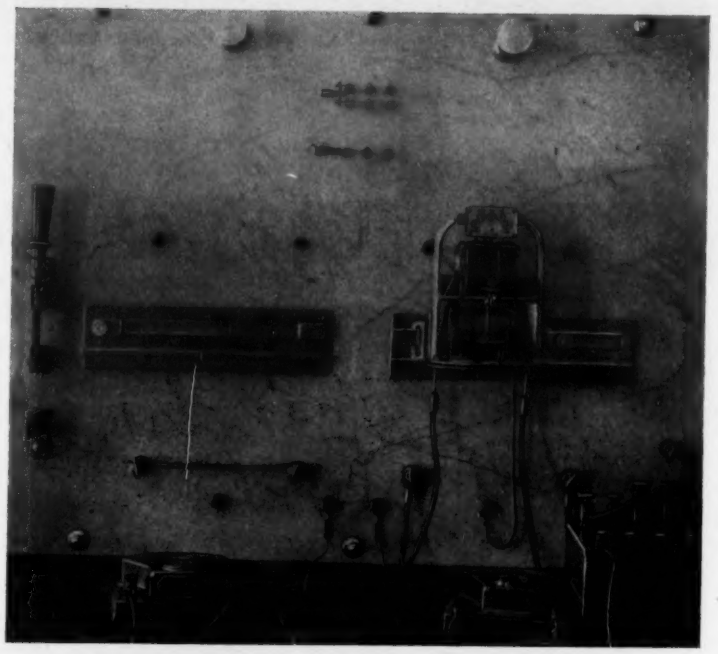


FIG. 2.—PANEL FOR DIRECT-CURRENT METERS.

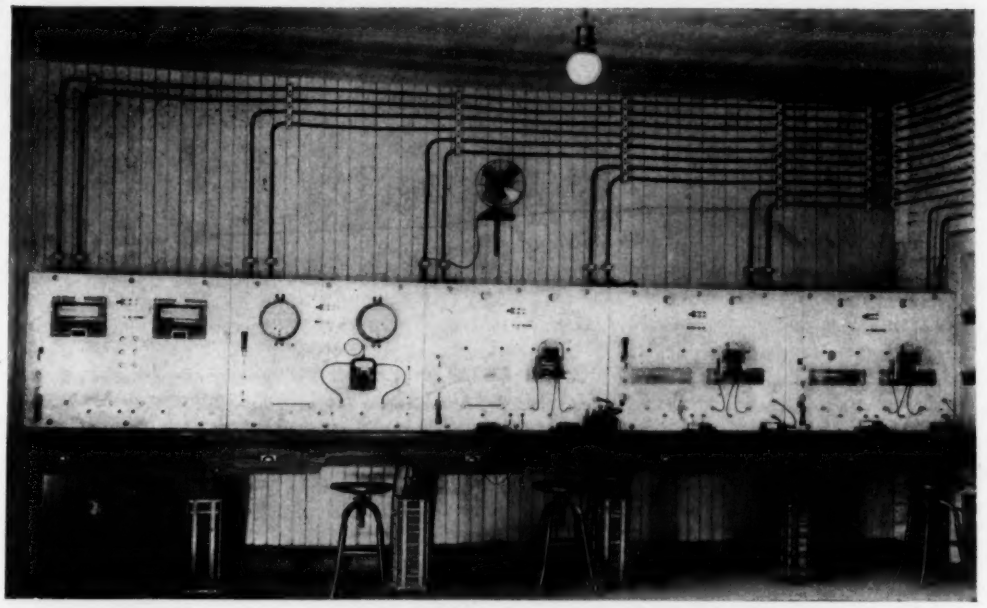


FIG. 3.—METER-TESTING BOARD.

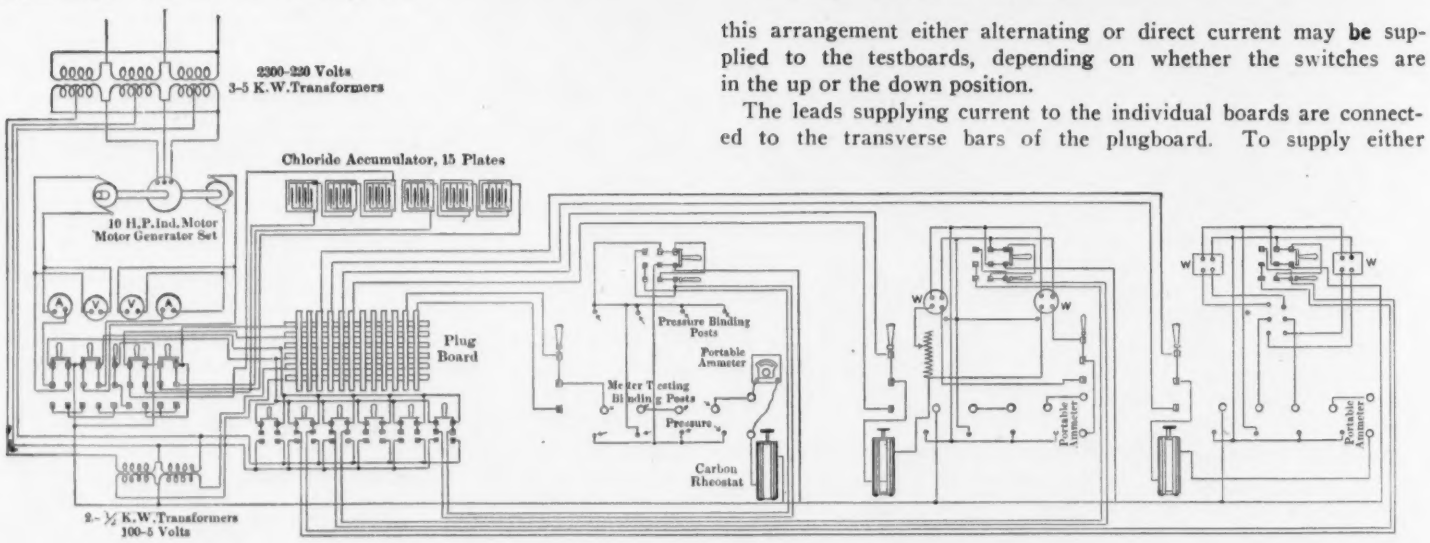


FIG. 1.—WIRING DIAGRAM OF TESTING CIRCUITS.

The leads supplying current to the individual boards are connected to the transverse bars of the plugboard. To supply either alternating current or direct current from either the battery or the motor generator, it is necessary simply to insert plugs in such a manner as to connect the proper transverse and horizontal bars.

The meter test boards are well shown in Figs. 2 and 3. Each

board is provided with two adjustable racks for holding the meters, which are usually tested two in series. The current is always supplied from the neutral and one of the outside wires. A single pole, double-throw switch permits of reversing the current through the meters. In the direct-current testing, portable instruments are used, as may be observed in Fig. 2. The carbon rheostat connected in the circuit is made up of flat plates of carbon placed in immediate contact with each other (Fig. 3). An adjusting screw projecting from the top permits of variation of pressure on the piles of carbon and consequently variations of resistance. As the voltage carried is so extremely low, the loss of energy due to the heating in the rheostat is comparatively small. A combination effected by means of a double-pole, double-throw and a single-pole, double-throw switch permits of different connections with the circuits for supplying current to the shunt coils. When both switches are thrown to the right, as in the diagram, the pressure binding posts of the test board are connected between the neutral and one of the outside wires. Throwing the single-pole, double-throw switch to the left simply reverses the current through the shunt coil. When the upper switch is thrown to the left, current is supplied to the binding posts from the outside or the 220-volt leads. Two of the five boards are arranged especially for testing alternating-current meters. These are supplied with the switchboard type of watt-meters.

The whole system, while at first glance having the appearance of being very complicated, is in reality comparatively simple. Its strongest feature is its flexibility and the ease with which different changes may be made.

LETTERS TO THE EDITORS.

Grounded Secondary and Lightning Protection.

To the Editors of Electrical World and Engineer:

SIRS:—Theoretically, wiring a house for electricity and connecting the wiring to a grounded secondary should be at least some help in protecting the house from lightning, in accordance with Faraday's experiments. I should be very much obliged if some of your readers would express an opinion as to how far this protection would be of benefit, and as to whether there have been any cases where the lightning has struck either the outside or the inside of a house wired for electricity and connected to a grounded secondary.

BOSTON, MASS. R. S. HALE.

Tree Telegraphy.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with much interest the communication of Mr. John M. Blake in your issue of February 11 on the use of trees in wireless telegraphy, and I shall not be surprised if subsequent tests by Mr. Blake, or others, confirm his experiments, and also that much greater distances will be accomplished by this simple method of signalling.

In wireless telegraphy, the signalling distance depends not only upon the power of the emitter and the sensitiveness of the detector, but also upon the emitting and absorbing radiation efficiency of the antennae circuits as a whole.

In this connection, investigation shows that both the aerial and the earth area surrounding its base to a distance of at least a quarter wave length of the radiations employed, should be considered.

It has been found that signals can be received, without actual contact with the receiving antenna, but directly from the earth itself immediately adjacent to the foot of the antenna and under its influence.

By this method of utilizing trees for wireless transmission of intelligence, what has heretofore been an obstacle is converted into an instrumentality.

The necessity for a good "earth" for the receiving antenna as well as the transmitting antenna is important, and on this point there is no more intimate connection between the earth and the space above the earth, filled with air—than is found in vegetation, which, in fact, lives and grows from the constituents of both.

As is well known, the root system of a tree is composed of organized vegetable cells filled with saps and juices, composed of water, starch, cellulose, various vegetable acids and mineral substances, depending upon many conditions well known to the botanist.

The larger roots of a tree are covered with innumerable microscopic hair roots and rootlets, through the surfaces of which the tree obtains its nutrition from the soil and the general vegetable circulation is maintained, and the fluids thus involved in this circulation in the organized cells, have been found to be good absorbers and conductors of electro-magnetic waves of Hertzian frequencies.

The comparatively limited height of trees as antennae may be compensated for by suitably grooping a number of trees, by means of which the energy of the electromagnetic waves absorbed, may be multiplied almost at will.

It is hoped in the interest of the advancement of our knowledge, that those with ample facilities will be induced to investigate this interesting branch of wireless telegraphy, and it is believed that no field, at present, offers greater promise to the investigator, both for practical and scientific results.

The entire apparatus for receiving becomes so simple that in the vicinity of any of the powerful transmitting stations, which are already established at several points in the United States, experimenting on these lines is reduced to its simplest forms, and requires neither an elaborate plant, nor a considerable expenditure of time and labor.

SAN FRANCISCO, CAL. GEORGE O. SQUIER.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

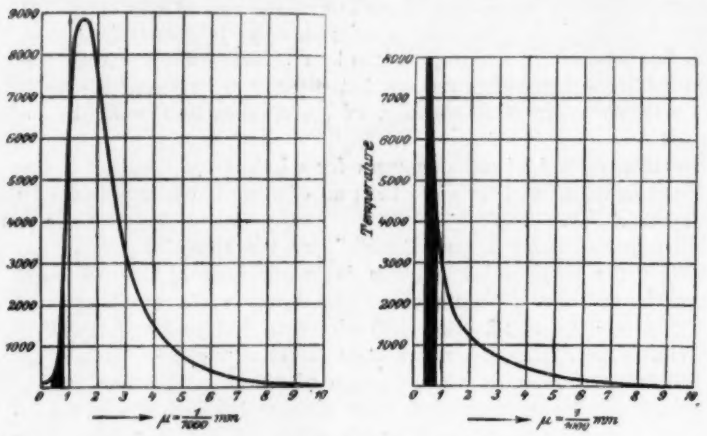
Armature Reaction in Alternators.—HENDERSON AND NICHOLSON.—A note on a paper read before the (British) Inst. Elec. Eng. The authors first discussed the theoretical aspect of the question, analyzing the magnetomotive force due to the armature current with regard to the distribution of the armature winding over the core, and calculating the resultant effect of the three phases of a 30-kw, three-phase alternator. The reaction is split up into demagnetising and cross-magnetising components, and a method of graphically predetermining the load curve for any output is developed. To put their theory to the proof, the authors carried out an elaborate series of tests upon the generator at various power factors and loads. Every precaution was taken to secure accuracy, and the numerous curves given in the paper, representing the results of the experiments, show a remarkably close correspondence between the calculated values and the actual observations, the deviations being negligible from the standpoint of the designer.—Lond. *Elec. Rev.*, January 27.

Single-Phase Motor.—BETHENOD.—A continuation of his mathematical article on the theory of the compensated single-phase series motor.—*L'Eclairage Elec.*, February 4.

LIGHTS AND LIGHTING.

Lighting.—WEDDING.—A paper read before the Cologne Electrical Society on progress in the lighting industry. Each wave length in a complex radiation has a certain amount of energy; if for instance, the light from the filament of an incandescent lamp is decomposed by means of a prism into its different wave lengths, it is possible to determine for each wave length the radiation energy. The curve in Fig. 1 gives the results obtained in a test in the Reichsanstalt, the ordinates representing the radiation energy and the abscissae the corresponding wave lengths. The maximum of this curve is at the abscissa 1.5μ, but the visible rays of the spectrum are between 0.4μ and 0.8μ, so that the maximum of the radiation is outside of the limits of visible rays. The energy which is useful in this case as visible light (between the wave lengths 0.4μ and 0.8μ) is blackened

in the diagram. It will be seen that only a very small amount of the energy is obtained as useful light. The higher the temperature, the smaller the wave length at which the radiation energy is a maximum. The highest economy, will, of course, be obtained if the maximum of the curve lies within a visible spectrum, that is between the abscissae 1.4μ and 1.8μ. Fig. 2 gives the temperatures as function of the wave lengths for which the radiation energy is a maximum. The portion which is blackened in the diagram corresponds to the wave lengths of the visible spectrum, and it will be seen that in order to get the maximum of radiation within these



FIGS. 1 AND 2.—LIGHTING.

limits, it is necessary to use temperatures of more than 3,000 or 4,000 degrees. The flame of the Argand burner has a temperature of 1,800 degrees. The maximum of radiation is in this case at 1.55μ; the carbon filament of the electric incandescent lamp has a temperature of 2,000 degrees, maximum of radiation at 1.4μ; the Nernst lamp filament and the Welsbach mantle have a temperature of 2,320 degrees and the maximum of radiation at 1.2μ; the electric arc lamp has a temperature of 4,000 degrees and the maximum of radiation at 0.7μ. In the following table the first column of figures gives the efficiency defined as the quotient of the energy given out in form of useful light (light of the wave lengths of the visible spectrum), divided by the total energy consumed by the lamp; it will be seen that even the best efficiencies in this table are below one per cent. The second vertical column gives the calories consumed per hour for the production of one spherical candle. The third column gives the cost per thousand candle hours in cents, but the author emphasizes that these figures should be used cautiously, since many other factors decide the advisability of using a certain light. The author gives some notes on the zirconium lamp which is not yet on the market although several lamps were exhibited at the meeting. The manufacture of the filaments is briefly described; and it is said that from one kilogram of zirconium 100,000 filaments can be made, and it is stated that the lamp will be sold at the price of 38 cents. The lamp consumes normally two watts per candle. Single-filament lamps are adopted for 37 volts, so that on 100-volt mains, three such lamps are used in series. Single filaments are also made for 44 volts, so that five such lamps are used on 220-volt circuits. In lamps of 60 to 100 candles, several filaments are used in one lamp, so that a single lamp may be connected across 110-volt mains. Recent life tests have given a life of 700 to 1,000 hours. Concerning arc lamp engineering, it is said that at present three lamps (without series resistance) are used in series across 110-volt mains, but this is recommended only for large consumers. The enclosed arc lamp has found more favor in the United States than in Europe, although it is increasing in importance now in Europe. The author mentions a new lamp of Tito Livio Carbone in which inclined carbons are used side by side as in the Bremer lamp, but the carbons are not impregnated with chemicals. By a special magnetic device, the arc is blown downwards so as to form a hemisphere. The voltage is 90, and the light is quiet and steady. However, the specific energy consumption is higher than in enclosed arc lamps. Beck has recently invented an arc lamp without regulating magnets, and the author states that the lamp has given good results in the laboratory. He provides one of the two carbons (which are placed side by side in a strongly inclined position) with a longitudinal ridge which rests on a refractory foundation. By the heat radiated from the carbon end, the terminal of the ridge becomes a fine point which burns away simultaneously with the carbon and thus causes the gradual and continuous descension of the carbon. As a strong competitor of electric arc lamps for public lighting, the high-pressure incandescent gas lamp is mentioned. The gas is compressed to a pressure of 100 mm. mercury and used in specially constructed incandescent gas burners, producing in a large double mantle more than 2,000 candles.—*Elek. Zeit.*, January 19.

	Efficiency.	Calories per candle per hr.	Cost per 1000 candle-hours in cents.
Kerosene lamp	0.000 29	36.4	21.
Gasoline	0.000 063	16.3	22.
Welsbach incandescent gas light	0.000 18	11.0	6.8
High-pressure incandescent gas light	0.000 65	6.48	4.5
"Lucas light"	to	7.82	4.8
"Millenium light"	0.000 96	5.77	3.5
Carbon filament electric lamp	0.002 to 0.0048	2.6 to 3.99	30. to 46.
Osmium lamp	0.006 2	1.34	16.
Nernst lamp	0.008 5	1.63	19.
Electric arc lamp	0.002 98 to	0.95	11.
Flame arc	0.003 38	0.2	2.3

Electric Lamps.—DAVIDGE.—An abstract of a paper on recent developments in electric lighting. According to the author the average "optical efficiencies" (the town is not defined) of various lamps are as follows: Incandescent lamp 5 per cent.; arc lamp, 15 per cent.; vacuum tubes and mercury vapor lamp, 33 per cent. Regarding the average consumption of electric energy per candle-power, he mentioned that incandescent lamps consume from 2¼ to 4½ watts per candle-power, enclosed arcs require from 2½ to 4 watts, the Nernst lamp consumes from 1½ to 2½ watts, while the corresponding figures for the open arc vary from 0.8 to 1.5. Candles were credited with a temperature of 1,700° C., incandescent electric lamps 1,830° C., Nernst lamps 2,180° C., arc lamps 3,930° C. (Compare these figures with those in the preceding abstract, which are in many cases quite different.) In the discussion Allingham drew attention to the fact that enclosed arc lamps are not more economical than Nernst lamps, the latter having, therefore, a fair chance of replacing in many cases the more complicated and costly enclosed arc lamp.—Lond. *Elec.*, February 10.

The Arc in a Magnetic Field.—CHILD.—An account of certain phenomena observed when the electric arc is placed in a magnetic field. If two carbon pencils are placed on the opposite sides of an arc, the potential difference between them is changed when the arc is deflected toward one of them by means of a magnetic field. This change may be as high as four volts. The effect cannot be produced by blowing the arc to one side, nor by moving the carbon pencils to one side of the arc. Rapidly reversing the field, and with each reversal, interchanging the connections to the voltmeter, does not diminish the effect. The effect decreases as the strength of the field is diminished. Changes in the current through the arc do not appreciably influence it. It is, however, increased by lengthening the arc. The effect is smaller with cored than with solid carbons. It decreases and in some cases entirely disappears when salts are placed in the arc, and it could not be detected with an arc between metals. An attempt was made to observe it with graphite terminals, but it was impossible to maintain an arc between such terminals when in a magnetic field. The effect decreases as the pressure on the surrounding gas is diminished and with a pressure of approximately 1 cm. of mercury it disappears. The common equation for the Hall effect does not apply in this case, since there is here a motion of the ions transverse to the direction of the impressed e. m. f. It is possible, however, to explain almost all of the observations by assuming that the positive ions move more rapidly than the negative ones.—*Phys. Rev.*, February.

Mercury Arc Lamp.—VALBREUZE.—A summary of recent progress in mercury arc lamps.—*L'Eclairage Elec.*, January 28.

POWER.

Fuel Economy in Steam Power Plants.—BOOTH AND KERSHAW.—The first parts of a paper presented before the (British) Inst. of Elec. Eng. on the various possibilities of economizing fuel in steam plants. The authors first discuss the feed water, and state that only very few natural waters are fit for use in steam boilers without some preliminary treatment; chemical examination alone can reveal whether this treatment is required, and what must be its character. The authors deal briefly with the analysis of feed water, with softening apparatus, scale and grease troubles and pre-heating and thermal storage. Concerning the latter point they say that the subject is well worth more study than it has yet received, for the facts relating to the gain in boiler efficiencies when fed with water at or above 212° F. seem indisputable, and when a satisfactory explanation of the cause has been given, engineers will no doubt be ready

to adopt pre-heating and thermal-storage plant to a much greater extent than is now the case. The steam boiler of the future is likely, in fact, to be specially designed for this double duty of pre-heating its feed water and providing steam. The authors then pass over to the discussion of fuel supply and they think systematic sampling and testing of the fuel would in many cases be found to save money. The supplies of fuel, whether cheap or dear, ought therefore to be subjected to regular sampling and testing. A check upon the colliery supplying the fuel is afforded by the laboratory examination, and thus is useful not only in maintaining regularity in the quality of fuel supplied, but also in affording a basis for the new contracts which are made from time to time.—Lond. *Elec.*, January 27.—In discussing the air supply they state that the advantages to be gained by a pre-heated air supply are very great, and it is surprising that hitherto so little attention has been given to this subject. The limit of improved efficiency possible in this direction, is that imposed by the ability of the steel used for boiler construction to withstand very high pressures of 150 lbs. or 200 lbs.; but no doubt the resisting qualities of steel plates in this respect could be greatly improved, and the more general use of refractory linings to the boiler would also assist in meeting this difficulty. In discussing boilers and furnaces, the authors state that the joints of a boiler will depend upon the circumstances of each particular case. They briefly summarize the characteristic features of the more prominent boiler types. The economy possible from many appliances lies entirely in the possibility of using a cheaper fuel. Unscientifically designed furnaces are unfortunately of lowest first cost. Only, however, by suitable furnaces can the minimum of cost be secured, and the great economy usual with cheap coal, is only to be had where furnace forms, draught, and lining are correct.—Lond. *Elec.*, February 3.—The authors discuss briefly the radiation and air leakage; stoking; smoke prevention; and then speak of superheated steam. There is no thermodynamic gain from superheat. The sole function of superheat is to ensure that steam, saturated with heat, and at maximum density per cubic foot for its pressure, shall be present in the cylinder to work expansively when steam is cut off from the boiler. Superheat is thus intended to heat the cylinder as hot as the boiler, and, by avoiding the presence of water in the cylinder, to minimize the exchanges of heat between the cylinder metal and the steam.—Lond. *Elec.*, February 10.

Condensing Plant for Steam Turbines.—An editorial note referring to the objection sometimes made against steam turbines that their condensing plant requires extraordinary amounts of cooling water to secure the high vacuum which is so necessary for the efficient working of this kind of engine. Addenbrooke, for instance, pointed out in the discussion of Merz and McLellan's paper on power station design, that a 10,000-kw, turbine-driven generating station required about 1,000,000 gallons of cooling water per hour. In a paper a long abstract of which is given in the same issue, Bailie contends that the more perfect design and arrangement of modern condensers and pumps enable vacua of say, 28 in. of mercury to be obtained with no greater allowance of cooling surface and cooling water than has hitherto been considered requisite for lower vacua. The tests quoted by the author certainly show that high vacua are obtained in practice, and it is interesting to compare the amounts of condensing water with Addenbrooke's estimate. Taking the figures for the Manchester station, for instance, and assuming proportionality between cooling water and output, the cooling water required per hour for a 10,000-kw plant would amount to some 980,000 gallons, a figure not very far short of Addenbrooke's estimate. However, the temperature of the cooling water at Manchester was 82° F.—a high but not exceptional temperature. In the case of the Neepsend (Sheffield) generating station, on the other hand, much better figures were obtained, working out to 550,000 gallons per hour per 10,000 kw., the vacuum in this case being 27.7 in. with a barometer at 29.9 in. and the temperature of the cooling water being 65.3° F. With the exception of the case of the Hulton colliery, the power taken by the pumps was but a small fraction of the total power generated, ranging, in fact, from 2 to 2.3 per cent. These figures are comparable with the 2.5 per cent. mentioned by Bibbins for a 400-kw American plant.—Lond. *Elec.*, February 10.

Electricity in Mining.—DE LAVAL.—An illustrated account of the latest work done in the deep mines of the Comstock lode. The application of electricity on the Comstock, not only in pumping but hoisting and for general power purposes in the mines, was introduced about four years ago. The power is generated by the Truckee River; the transmission voltage is 24,000; the length of the line is 35 miles to Virginia City. The charge is $7 per hp-month. There is installed on the Comstock lode about 2,000 hp, which will soon be increased to about 5,000 hp. All motors of 50 hp or more are operated directly on 2,240 volts, all smaller on 440 volts, and the lighting circuit is 110-volt, two-wire, or 220-volt, three-wire.—*Jour. of Electricity, Power and Gas,* February.

Transmission Plant.—BUCHENBERG.—An illustrated description of the transmission plant of the Martinsburg Power Co., by which energy for lighting and power is transmitted from the Potomac River to the city of Martinsburg, a distance of 12 miles. The hydro-electric plant contains a 450-kw, 60-cycle, 13,200-volt alternator.—*The Engineer,* February 15.

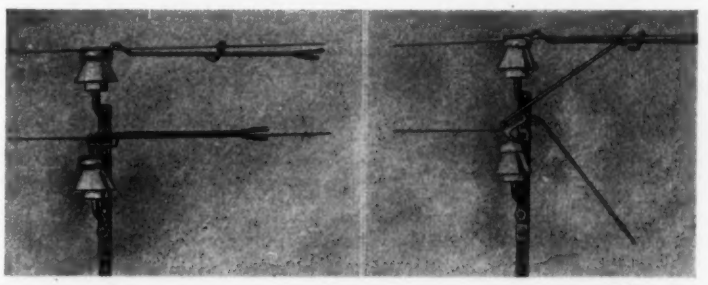
Water Power Plant.—An illustrated description of the hydro-electric power plant of the North Mountain Power Company, of San Francisco, which is to serve Humbolt Bay and Eureka, in Humbolt County, Cal. It is a 25-cycle installation and is, therefore, primarily a power rather than a lighting plant. Wherever there are lighting loads to carry, the frequency for such service is raised through motor-generator sets to the usual 60 cycles. The power plant contains two 750-kw, three-phase machines generating at 2,200 volts. For transmission the voltage is raised to 33,000.—*Jour. of Electricity, Power and Gas,* February.

TRACTION.

British Interurban Tramway Line.—An illustrated article on the Birmingham and Midland tramways which have a length of 11.8 miles. The power house contains three alternators, each of 500 kw, generating three-phase currents at 5,000 to 5,500 volts, and at a frequency of 25 periods. There are also three direct-current generators, each of 300 kw capacity. The latter supply current to the tramways in the neighborhood and also to the three-wire electric lighting system of the town of Smethwick. The three-phase currents are transmitted to two converter sub-stations.—Lond. *Elec.*, February 10.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Preventing Danger from the Breaking of High-Tension Lines.—An illustrated description of devices of Giraud which are used on a French three-phase transmission line. The device utilizes the mechanical horizontal reaction which is produced on an insulator in the moment when a conductor breaks. This sets immediately a mechanical device in motion which produces a short circuit by which a circuit breaker is brought into action. One construction may be seen from Figs. 3 and 4.—*L'Industrie Elec.*, January 10.



FIGS. 3 AND 4.—SAFETY DEVICES FOR HIGH-TENSION LINES.

British Combined Lighting and Traction Station.—An illustrated description of the Colchester electricity plant which supplies 7 miles of single track tramways and current for lighting and power purposes. There are three dynamos of 62 kw, one of 225 kw, one of 160 kw and two of 260 kw. The latter three machines are used for traction; a storage battery being also installed. The system of supply for lighting is three-wire at 210 volts on either side of the neutral with 420 volts for power.—Lond. *Elec. Rev.*, February 3.

Load Factor.—HILL.—A popular article discussing the meaning of the term load-factor and its influence on the cost of electrical energy. The subject is explained by means of an analogy with the profits obtained from a public hall rented out for pleasure purposes.—Lond. *Elec.*, February 10.

Switchboards.—PECK.—In a continuation of his illustrated serial on modern practice in switchboard design, he deals with switchboards for railway and power service.—*Elec. Club. Jour.*, February.

ELECTROPHYSICS AND MAGNETISM.

Undamped Electric Oscillations.—MAISEL.—A paper in which the author offers a theory of the undamped electric oscillations occurring in Duddell's singing arc, which is different from the theories hitherto furnished by Duddell, Janet or Granquist. These latter postulated a "negative resistance" in order to account for the constant renewal of the energy of the undamped oscillations. This is, according to Maisel, not justified on the one hand, and insufficient on the other. For he has observed singing arcs in which dv/di was positive. He supposes a conductor AB, Fig. 5, which rigidly obeys Ohm's law, with the proviso that no current flows when the e.m.f.

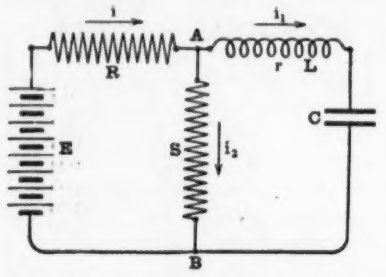


FIG. 5.—UNDAMPED ELECTRIC OSCILLATIONS.

falls below a certain value, and that the restoration of the current requires a high e.m.f. This conductor is a simplified arc, and is better for theoretical purposes than the ordinary arc, about which we know as yet very little. In fact, the arc is only one of the things which can produce undamped oscillations. The author works out a complete mathematical theory of the phenomenon, and shows that the energy required to neutralize the damping is constantly supplied by the battery. In every phase of each oscillation there is damping, and it may be very strong. But the resulting discontinuity of the circuit enables the battery to cover the loss. This discontinuity surcharges the condenser c. During charging, the condenser receives so much energy from the battery that during discharge the potential of the condenser falls much lower than it would in the case of a continuous current. If this potential is low enough, the vibrations go on indefinitely as long as the battery works.—Lond. *Elec.*, February 10. from *Phys. Zeit.*, January 15.

Magnetic Susceptibility of Liquids.—MESLIN.—An account of an investigation in which the author has endeavored to introduce some order into the chaos of values assigned by various experimenters to the magnetic susceptibility of organic liquids by reducing them all to unit volume instead of unit weight. He has also determined some 30 values, which he tabulates in conjunction with those of Henrichsen, Quincke, Becquerel, Faraday and Plücker. The liquids are all diamagnetic, and their susceptibilities range from 0.475 for ethyl iodide to 0.908 for petroleum. Water, benzine and touluene stand in the middle at about 0.8.—Lond. *Elec.*, February 10; from *Comptes Rendus*, January 23.

New Radium Mine.—DANNE.—Radium has hitherto been found only in connection with uranium ores. The present author, has, however, discovered a new source of radium at Issy-l'Évêque, in the department of Saône-et-Loire, where it occurs associated with pyromorphite, and also to some extent with lead-bearing clays and pegmatite. Some of the ores show, without further preparation, a radio-activity several times that of uranium, but usually it is less. In any case, a ton of mineral would yield quantities of radium bromide of the order of 10 milligrammes, and Messrs. Armet de Lisle at Nogent-sur-Marne, have taken in hand the exploitation of the mine. The wells in the neighborhood are all radioactive.—Lond. *Elec.*, February 10; from *Comptes Rendus*, January 23.

Radioactivity.—BROWNSON.—An account of radioactive measurements by a constant deflection method.—*Am. Jour. of Science*, February.

ELECTROCHEMISTRY AND BATTERIES.

Aluminum Anode Film.—GORDON.—An account of a Physical Society paper on the capacity and resistance of the film on the aluminum anode. The following is a summary of the main results: The capacity of the film is inversely proportional to the volts used to form the film. For water solutions, the capacity of the film varies but slightly with the nature of the electrolyte, provided, of course, the electrolyte is such as to form a film at all noticeable. The capacity of the films formed in molten electrolytes is much less than those of water solutions. The capacity of the films in molten electrolytes, increases rapidly after the voltage applied to form the film is taken away, indicating a rapid dissolving of the film in molten electrolytes. The resistance of the films is much less than is given by many investigators.—*Phys. Review*, February.

Calcium Cyanamide as Fertilizer.—FRANK.—An address held before the Farmers' Club in Berlin. Calcium cyanamide is now made on a commercial scale; one hp-year produces the fixation of 250 kg of nitrogen in form of cyanamide; however, this represents still a low efficiency as the theoretical output of one hp-year is about three times greater. The material has proven very satisfactory for fertilizing purposes.—*From an advance copy of the Address.*

Diaphragm Cell for Sodium Chloride Electrolysis.—ROSTOSKY.—An illustrated description of the MacDonald cell as used in various mills in Colorado in connection with the chlorination process of gold ores.—*Zeit. f. Elektrochemie*, February 6.

Electrolysis.—ROSSET.—The first part of a serial on the phenomena of electroylsis. A summary of the serial will be given when it is concluded.—*L'Eclairage Elec.*, January 21.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Phase Indicator.—When two circularly-polarized fields of equal amplitude, but of opposite directions, are superposed, the resulting field will be linearly polarized, and its azimuth will depend only upon the phase difference of the two original fields. This principle has been applied by Simon to the construction of a phase-indicator for electric currents. When two rotating magnetic fields are superposed, an alternating magnetic field will result, whose azimuth will indicate half the phase difference of the two original fields. Any phase difference between 0 and 2π can thus be measured, independent of the frequency—which influences other phase-indicators—and the phenomenon can well be demonstrated with the aid of two small three-phase generators and a Braun cathode tube, which shows the deflection of cathode rays by magnetic fields. The shafts of the two generators are coupled, and the currents of the generator are taken through two pairs of three coils, wound about a ring of iron. Each generator produces a revolving magnetic field, and this field acts upon the cathode rays, which undisturbed would mark a fluorescent spot. Each field tends to move the spot round in a circle, and when both fields are excited, a fluorescent line becomes visible, whose azimuth will change when the phase difference between the two current systems is altered. Such a change can be brought about, for instance, by an alteration in the coupling; if the coupling is formed by an elastic shaft, the torsions of this shaft will become apparent. As the cathode tube is not convenient, Simon described another arrangement. The iron ring is placed horizontally, and a length of a magnetized steel wire is fixed in the axis of the ring in such a way that a little mirror, attached to the top of the wire, lies in the plane of the ring. The wire is made to oscillate like a cord. A ray of light falling normally upon the mirror will then indicate the azimuth of the oscillations, which is observed on a graduated circle above the ring. The device can be tuned, and thus be rendered fairly sensitive, though it does not possess the light sensitiveness of a galvanometer. Another arrangement is suitable for examining the uniformity of the working of an electric motor. If we imagine each of the two generators to drive a synchronous motor —the two should revolve in opposite directions—and fix a disc with one slot to the shaft of each motor, then rays of light passing parallel to the shafts will mark, on a screen, a line of light corresponding to the phase azimuth, and if the two discs revolve in the front of a graduated dial, only the division indicating the phase difference will be visible. In practice one slotted disc is fixed to the flywheel of the motor in question, the other to the engine-shaft. With similar arrangements the torsional vibrations of propeller shafts can be studied at a distance. Simon particularly recommends his device, however, as a substitute for the compass on iron ships. If we use the horizontal component of the terrestrial magnetic field as field for the one generator, couple the generators, and place their axis vertically, then the one field will be stationary in space, and the other will change its direction with the position of the ship. The phase difference read off will hence mark the deviation of the ship's axis from the magnetic meridian, and the whole device would replace a compass. Similar proposals have been made by Weber and others, but have not been adapted on board; and it is

thought Simon's instrument will not be more successful for this special purpose.—Lond. *Eng'ing*, February 10.

Eddy Current Brakes.—BRION.—A paper read before the Dresden Electrical Society on the construction of large eddy-current brakes for testing purposes. If the phenomena in the copper disc itself are considered, Ohm's law in its simplest form would lead to the result that the torque is proportional to the product of the speed and the square of the field strength, and the power is proportional to the square of the product of field strength and speed. In reality it is found that if the excitation is maintained constant, the torque first increases approximately as a linear function of the speed; when the speed is further increased the torque reaches a maximum and afterwards decreases gradually while the power increases only very slightly. The higher the speed, the greater is the armature current and the greater is the distortion of the primary field, exactly as in a direct-current dynamo with large armature reaction. This distortion can be shown experimentally. A practical consequence is that it is useless to employ broad pole-shoes. If the speed remains constant and the excitation is increased, curves are obtained which are similar to magnetization curves, if the excitation is used as abscissa and the torque as ordinate, but up to the highest permissible excitation the torque still increases approximately as a linear function of the excitation, which may also be explained by the reaction of the armature currents or the eddy currents in the copper disc. It will be seen that as many ampere turns as possible should be used for excitation, if a strong effect is to be obtained with the brake. The dimensions of the air-gap have a great influence; roughly the decrease of torque is proportional to the increase of the air gap between the pole shoes; this is due to an increased stray field and to a diminution of the field strength. There are included descriptions of several tests which were made with an eddy-current brake.—*Elek. Zeit.*, January 19.

Electrostatic Damping of Galvanometers.—EINTHOVEN.—A description of a novel method of damping galvanometers. It is based upon the action of a condenser shunted on the galvanometer circuit. The formula showing the connection between the deflection a at time t and the constants of the condenser is $a = A\left(1 - e^{-\frac{t}{wc}}\right)$ where A is the permanent deflection, c the capacity, and w a resistance defined by the equation $w = \frac{WiW_o}{Wi+W_o}$, Wi being the resistance of the galvanometer and Wo that of the external circuit. The product wc is the "time constant" of the galvanometer. If w is given in ohms and c in farads, wc appears in seconds. By changing w and c, the time constant may be made to acquire any desired value, and the damping may therefore be regulated at will. The author produces some curves showing the aperiodic nature of the deflections. In one curve, the final deflection is attained in 0.026 seconds with one microfarad, and the curve shows no trace of oscillations. The best type of galvanometer for this method of damping is the string galvanometer. With a quartz fibre tightly stretched, it ought to be more sensitive than the oscillograph.—Lond. *Elec.*, February 10; from *Ann. der. Phys.*, No. 1, 1905.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Resonance in Wireless Telegraphy.—PIERCE.—An account of a Phys. Soc. paper in which the author described experiments on the conditions for resonance in wireless telegraph circuits with various lengths of vertical wire. The circuits employed were of the electromagnetically connected type. The receiving instrument was a high-frequency dynamometer in which a silver disc (3 mm in diameter) is hung near a small coil (8 mm in diameter) of about 30 turns of fine wire. The coil is put in series with the condenser circuit at the receiving station. The disc hangs at an angle of 45° with the plane of the coil. Oscillating currents in the coil induce currents in the disc, which is deflected so as to increase the angle between the disc and the coil. By withdrawing the coil, increasing its distance from the suspended disc, the sensitiveness of the instrument may be diminished, giving the instrument an extremely wide range, so that in a single experiment quantities of energy in the ratio of 1 to 20,000 were compared. The deflections of the instrument are proportional to the square of the current in the coil. With various vertical wires, containing from one to eight wires of which the length was varied from 4 to 24 meters, it was found that the capacity of the receiving antennae (assumed proportional to its length) is related to the resonant capacity of the condenser in the receiving side circuit in a manner expressed approximately by a hyperbolic equation—*Phys. Rev.*, February.

BOOK REVIEWS.

DAMPFTURBINE. By Gabriel Zahikjanz. Berlin: Bickel & Co. 24 pages.

The first two sections of this pamphlet are intended by its author to relate to the theory of the steam turbine and to its embodiment in existing turbines. The treatment is fragmentary, without mathematics, and gives only a remote idea of the actual problems involved or of their solution in existing types. The third section is concerned with the description of the author's turbine and with its relation to the theoretical conditions previously laid down. As a whole, the pamphlet is not general, but particular, and is only of interest as it relates to the special form of turbine proposed by the author.

TRANSVERSAL DAMPFTURBINEN. By A. Patschke. Mulheim: Max Roder. 73 pages, 16 plates in pocket. Price, 2.50 marks.

This pamphlet is written primarily for the purpose of describing the special type of turbine proposed by its author. The details of this type of construction both from the structural and the theoretical viewpoints are fully set forth and copiously illustrated by the accompanying plates. The pamphlet as a whole forms an interesting addition to the literature of the steam turbine, and those who are keeping close watch on all possible lines of progress in this field will profit by this exposition of the "transversal" type.

BAU DER DAMPFTURBINEN. By Alfred Musil. Leipzig: B. G. Teubner. 233 pages, 102 illustrations. Price, 8 marks.

The increasing importance of the turbine as a factor in power plant practice is shown by the increasing number of books, large and small, dealing with some phase of the broad subject. While professing to deal only with the constructive aspects of the turbine, the author gives, nevertheless, a brief but very satisfactory presentation of the main elements of turbine theory, and discusses with especial clearness the thermodynamic aspects by means of the temperature entropy diagram for the history of the steam. This is followed by chapters discussing in detail the various constructive and operative points of the leading types of turbine, represented by the De Laval, Parsons, Zoelly, Riedler-Stumpf, Curtis and Rateau. The descriptions are clear and the text is well illustrated with numerous constructive cuts and half-tones. Taken as a whole, this work furnishes for German readers an exceedingly well written, concise and yet comprehensive view of the modern steam turbine, and its possibilities and promise as a factor in the industrial world.

DIE DAMPFTURBINEN. By Hans Wagner. Hannover: Gebruder Janecke. 146 pages, 150 illustrations. Price, 8 marks.

This book is intended by the author to set forth in compact form the theory, construction and operation of the steam turbine as a factor in the steam power plant practice of the present day. In the first section, which is devoted to theory, general consideration is first given to the heat energy of steam and to its transformation into the energy of a jet by expansion through a suitable nozzle. The transformation of this jet energy into mechanical motion by reaction on suitable vanes is next considered, and the combination of such elements into the simpler types of steam turbine readily follows. The second section deals with construction with special reference to the practical form and disposition of the various details of the turbine as an actual machine. Illustrations are drawn freely from the field of practice, and brief descriptions are given of the principal turbine systems now before the engineering public.

The third section deals with operation and includes a general discussion of regulation, condensation of the steam, economy and adaptation to various special fields of industry. The book is well illustrated with diagrams and cuts referring to both theoretical principles and practical construction. As a whole the book gives for German readers a very satisfactory treatment of the main theory of turbine action and of the principal problems with which the designer and constructor must deal.

Electrically-Driven Lathes at the Washington Navy Yard Gun Factory.

By N. Monroe Hopkins, Ph.D.

THROUGH the courtesy of Capt. E. C. Pendleton, U. S. N., superintendent of the Naval Gun Factory at the Washington Navy Yard, the writer was given opportunity and assistance in obtaining the following data pertaining to the electrically-driven gun lathes in the north gun shop of the factory. These immense lathes, eight in number, are direct-driven by electric motors and have many interesting features. Seven of these lathes are capable of turning fourteen-inch guns, and the eighth is designed to produce a sixteen-inch weapon. Although this electrically-driven system as only been in operation for about two months, those concerned in its operation from the superintendents to the machinists are more than delighted with the change. The lathes were originally driven by the familiar cone and belt from a countershaft, which in turn was driven by a rope transmission from a steam engine.

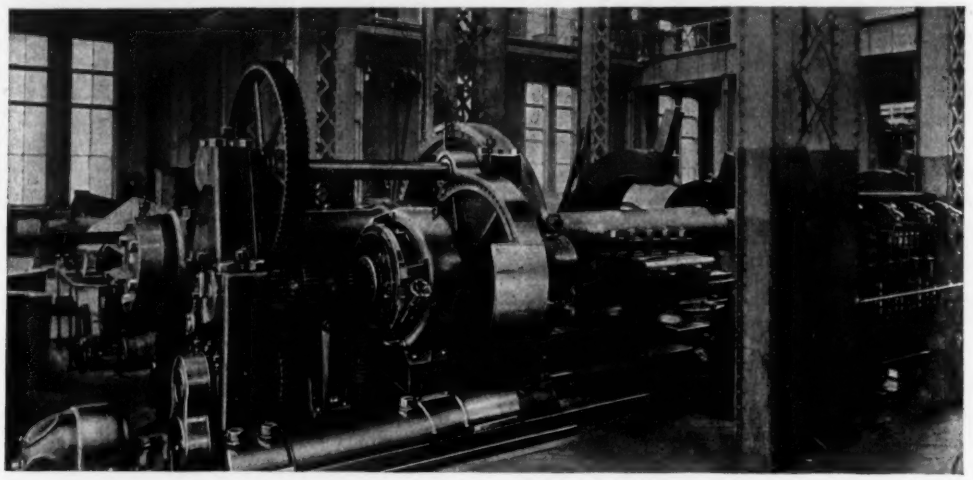


FIG. 1.—ELECTRICALLY-DRIVEN GUN LATHE.

The method of making the change from the old belted system to the present electrical drive is no less interesting than the equipment complete. Captain Pendleton appointed a board consisting of himself, Commander J. M. Bowyer, Mr. Robinson, foreman of the gun shops, and Mr. W. G. Reed, electrician of the Navy Yard. As a result of the conferences of this board, Mr. Reed was sent under orders of the Secretary of the Navy to travel and investigate the different systems of direct-connected electrically-driven machines throughout the country, and upon his return made a report and recommendations upon which the present splendid equipment is based. This board then invited several electrical companies to submit propositions for the electrical installations based upon the specifications of the board. Of these original propositions the Crocker-Wheeler Company came the nearest to fulfilling the requirements, and the electrical contract was awarded to this company.

Each lathe has been fitted out with a Crocker-Wheeler electric motor, of the engine-type generator frame, with six poles, and capable of delivering 56 hp. These motors are simple shunt-wound and were mounted upon the gun lathes by the mechanics at the Washington gun shops. Mr. Reed, together with Mr. Joseph W. Lawrence, master mechanic of the gun shops, made the change by removing the cones originally driven by the old belts and rope transmission, and turning down the cone shafts to a standard diameter of 5.37 in. to receive the motor armatures, constructed by specifications to be mounted upon a hollow bushing of bronze to slip over the cone shafts. The armatures arrived on these bronze bushings and it remained for the Navy Yard machinists to slip them over the cone shafts, and mount the frames upon the bed of the lathe. As these lathe beds have a rounding irregular shape it was necessary to bolt the motor frames first to specially designed brackets, which in turn were bolted to the lathe beds. Those familiar with machine work and accurate fitting will appreciate the great mechanical skill necessary to center the motor frame over the armature under these conditions.

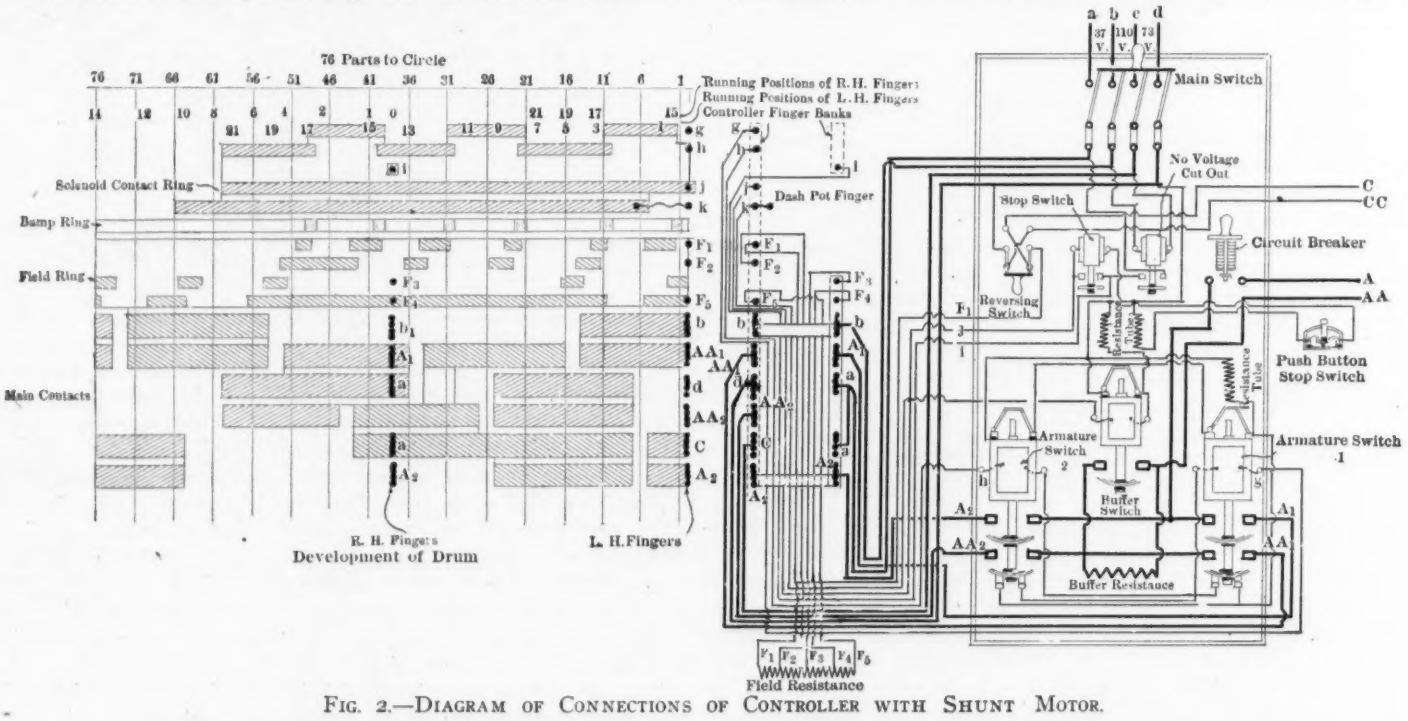


FIG. 2.—DIAGRAM OF CONNECTIONS OF CONTROLLER WITH SHUNT MOTOR.

Apart from the main driving motor, each lathe is equipped with a gauze-enclosed, four-pole, 10-hp Crocker-Wheeler motor, with

compound windings, the motor being mounted on a bracket attached to the bed of the lathe. These motors merely serve for running the heavy tool carriages rapidly back and forth over the long bed. Much time is saved through such handling of the tool carriages, which necessarily are very heavy. These are provided with a small starting panel having on it a rheostat, main line switch and overload circuit-breaker.

Current is supplied to the motors at six different voltages over four wires, as shown in the accompanying sketch. For starting purposes current under any of the following pressures: 37, 73, 110, 147, 183 and 220 volts. As a speed range of approximately 10½:1 is desired on these lathes, it was necessary to add a back gear run having a ratio with the direct run of 2.8:1. The change from one run to the other is easily and quickly made by means of a double jaw clutch operated by the lever shown in the cut. When using the fastest or direct run, the back gears can be thrown out of mesh in a similar manner to that employed on an ordinary engine lathe. On this direct run the motor's working speed range is from 444 to 183 r.p.m., or a 2.4:1 ratio in twelve steps, through which range the motor is good for 30 hp. Lower face plate speeds could be obtained by running the motor slower where full power is not required. By throwing in the 2.8:1 back gear, however, these low

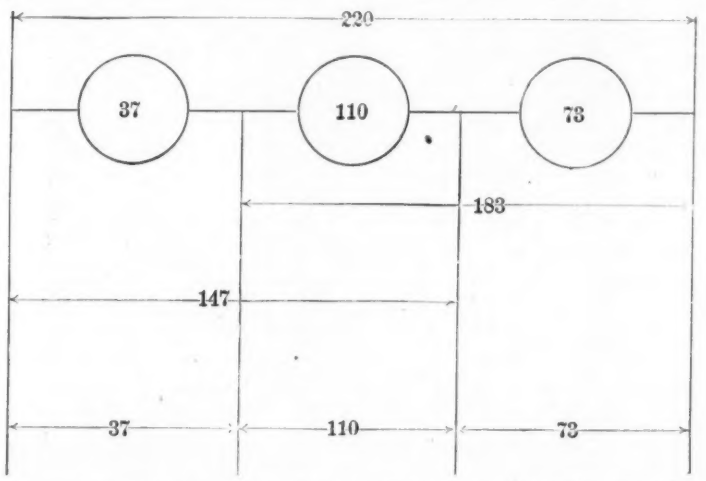


FIG. 3.—DIAGRAM OF MULTIVOLTAGE SCHEME FOR STARTING PURPOSES.

speeds can be obtained with full power. On this back gear run, as the power demand diminishes in proportion with the speed, the motor may be run at any speed and yet be sufficiently powerful. Therefore, using a motor speed range of 444:111 r.p.m., or 3.75:1 on this run gives a total face plate working speed range of 10.5:1 with a possibility of increasing it to 25:1 if very slow speeds are desired, as, for example, when adjusting the work in position upon the machine, and setting the cutting tools.

The speed variation of the motor is obtained by the use of the Crocker-Wheeler standard four-wire system, the controller being placed quite near the tool carriages. The controller proper is of the drum type. It makes the proper voltage and field weakening combination for each desired speed, but the main circuit is always broken outside of the controller by two solenoid switches, shown on the panel at the right of the cut.

On passing from one voltage to another, a third solenoid switch opens and inserts in the armature circuit a resistance called the "buffer resistance," thus preventing any undue rush of current that would otherwise occur. This resistance is automatically short-circuited at the end of a second or two. On the board there are also two small solenoid switches, so arranged that should any of the line voltages fail the main solenoid switches would open, and could not be closed until the controller drum is placed in the "off" position, thus insuring safety to the equipment.

Push button switches are located at convenient points on the lathes for the purpose of making a quick stop without the necessity of going to the controller. On the panel there are also mounted a four-pole fused switch, a circuit-breaker and the buffer resistance, referred to above.

At the time the writer inspected the plant, there were six lathes in operation and taking about 60 hp. The present installation is said to be saving the Government at least $10,000 a year over the old steam-driven system.

The power for motors is now supplied by a large unit in the Navy Yard power station, consisting of a McIntosh & Seymour tandem-compound, direct-connected to a 400-kw, 230-volt generator, making 130 r.p.m., of General Electric manufacture. Heretofore the lathes were driven by 250-hp, high-speed, cross-compound engines with the old rope transmission. These engines consumed 30 pounds of steam per hp-hour, as compared with 13½ pounds of steam with the present large engine. The old engines were situated alongside the lathes in the gun shops, and were about 400 ft. from the boiler. The steam pressure at the boilers in the old system was 100 pounds, and only 60 pounds at the engine throttles, involving a great waste. The present system, moreover, does away with three steam engineers at $2.96 a day, and three oilers at $2.00 a day and saves a considerable amount in waste through friction of wheels and countershafts, and much time that used to be lost by the breaking of belts and ropes in the old gear. At present the motor balances are looked after by the Navy Yard motor inspectors. The writer is indebted to Mr. Reed for much kindness and courtesy in procuring the data pertaining to this plant.

Hard Fibre Cleats.

At present hard fibre is coming to be much used as a substitute for wood and porcelain in the manufacture of cleats. Tough to a degree that eliminates all losses from breakage, it is claimed that the fibre cleats are perfect insulators, and their use results in a

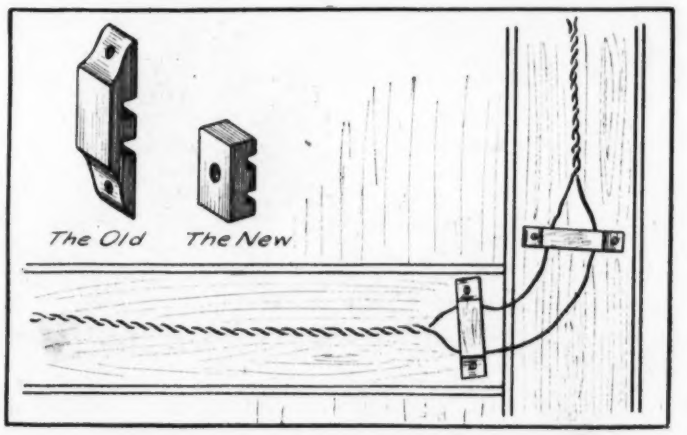


FIG. 1.—WIRING WITH WOODEN CLEATS.

neatness of wiring effects which can be made to harmonize with the most elaborate interiors, being practically equivalent in appearance to concealed work. The contrast between circuits as usually run and the improved installation when the compact fibre cleats are employed is shown in Figs. 1 and 2. The new cleats are no more

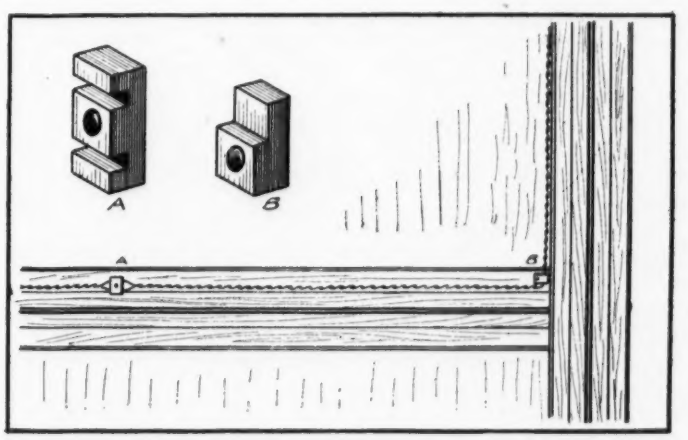


FIG. 2.—WIRING WITH HARD FIBRE CLEATS.

expensive in first cost than the porcelain cleats, while the fact that there is no breakage renders their ultimate cost for any given equipment much less than that of the cleats previously used. In many telephone exchanges the fibre cleats have been adopted as standard, while they are finding an extensive use for all classes of low-voltage wiring. The cleats shown in the illustrations are made by the Morris Electric Company, of Wilmington, Del.

Electric Pumping Plant for the Comstock Lode Mines.

No known mining district in the world has encountered greater difficulties than the Comstock has met, or will meet, in handling successfully the various problems. After various efforts to handle the water that was encountered 20 years ago on the 2,900-ft. level of Exchequer Mine in Gold Hill, it was finally decided to allow the water to fill to the Sutro Tunnel. About ten years ago another effort was made to unwater the mines through Crown Point incline, which also was abandoned after an expenditure of about half a million dollars, and future workings were confined to the 1,500-ft. level.

At this time hydraulic pumping engines were installed together with various Cornish engines, altogether of a capacity to keep the water at the 3,300-ft. level in the northern mines, but the expense of operating was so great that the mines were allowed to fill up to the 1,600-ft. level and workings were confined to the more accessible ore bodies above the Sutro Tunnel. The fact that the deposits which have been worked at the higher levels continue at the lower levels, has induced the mining companies to try every known expedient in order to reach them. Therefore, about four years ago a large hydraulic lift was installed at the Consolidated California Shaft, and with this appliance the water level in the north end has been kept below the Sutro Tunnel level at about 2,150 ft. and a considerable amount of valuable ore has been taken out, amounting to over $1,000,000. Having reached this level another effort was made to go lower, installing an electric pumping plant of the most modern type, consisting of three Reidler electric pumping engines driven by 200-hp induction motors. These pumps take the water at the 2,150-ft. level and, together, discharge 4,500 gallons per minute into the Sutro Tunnel under 430 ft. head. The hydraulic pumping engine serves as a sinking pump, discharging into a tank at the Reidler pump.

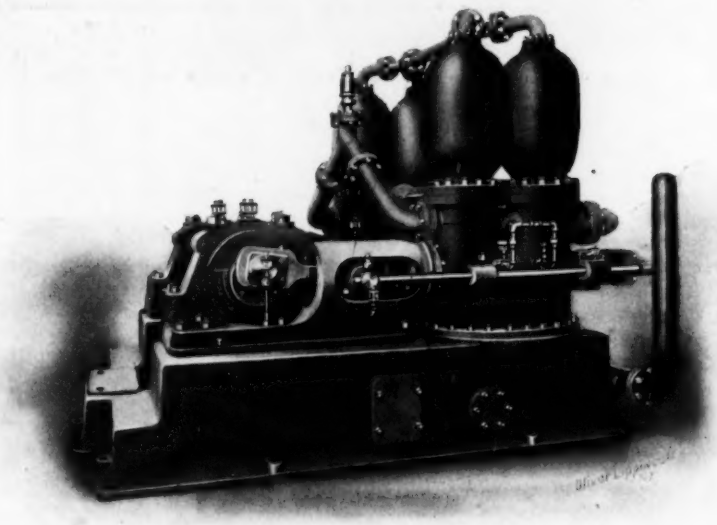


FIG. 1.—ELECTRIC MINE PUMP.

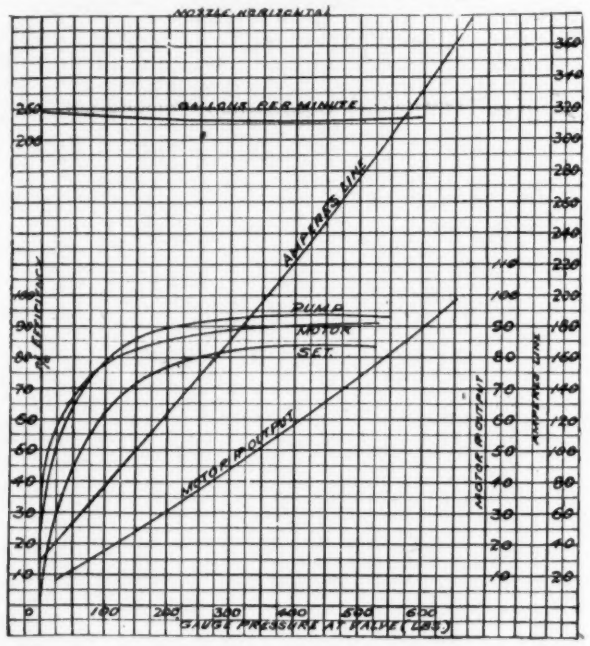


FIG. 2.—LOAD AND EFFICIENCY CURVES OF ELECTRIC PUMP.

The application of electricity on the Comstock Lode, not only in pumping but in hoisting and for general use in mining, was introduced about four years ago by Mr. Leon M. Hall. The power is generated on the Truckee River, about two miles east of Floriston, where McCormick turbines are directly connected to Westinghouse three-phase generators of the revolving armature type. Each pair of wheels will develop about 1,400 hp under a head of 84½ ft. Regulation is effected by Lombard governors. The generator potential of 500 volts is raised to 24,000 volts by Westinghouse oil-insulated transformers and the current is transmitted about 35 miles to Virginia City over a double circuit of copper wire. The mining companies purchase power from the Truckee River General Electric Company, the amount used being based upon a peak load of two minutes' duration when the electric hoists are operated directly upon the lines. The price is $7 per hp per month. There is about 2,000 hp of apparatus installed on the Comstock Lode, which will soon be increased to about 5,000 hp, as a contract has lately been closed between the Truckee River General Electric Company and the 32 mining companies comprising the Comstock Pumping Association, which calls for the delivery of electric power for draining the Comstock mines, lighting, hoisting, etc., the maximum amount being 5,000 hp.

In order to fill these contracts for additional power the Truckee River has prepared plans for a second electric generating station and a new pole line. Water will be diverted from the Truckee River and conducted to the extreme eastern end of the company's hydraulic system, where it will be utilized by water wheels under a head of 141 ft. For the maximum of 5,000 hp the rate will be $4.50 per hp per month with proportional rates for lesser amounts. This is based upon motor readings and will save the mining companies a considerable amount of money as compared with the existing contract. All motors of 50 hp and over are operated directly on 2,240 volts, all smaller motors on 440 volts, and the lighting circuit is 220 volts, three-wire system, except in the Gould & Curry mine, where it is 110 volts. For the ventilation of the mines, cold air is forced by electric fans to the different headings and stations.

The electric hoisting engines are of Mr. Hall's design and the most complete, satisfactory and economical that can be found, utilizing the balanced or tail rope system of hoisting.

The reason for installing the Reidler pumps at the C. & C. shaft in 1902 was the inability to go any farther than 450 ft. below the Sutro Tunnel level with the power from the hydraulic water supply for the hydraulic elevators, which proved most practical sinking pumps. Although the efficiency is only 25 per cent., the cost of repairs is small and this type of sinking pump is fully as reliable as any other appliance for this purpose.

The Reidler electric pumping plant handles not only the mine water, but also the pressure water when the hydraulic elevators are used for sinking. However, when the shaft is free from water another pumping plant is to be placed at the 2,550-ft. level, abandoning entirely the use of the hydraulic elevators.

The Reidler pumps are of the mechanically-operated valve type and run at 110 r.p.m. This gear accomplished its object for high speed when first introduced, but of those pumps that have been fitted with it in many instances the positive valve gear has been removed and the pumps have been operated with equally as good success without the gear. An instance of this is a pumping engine designed by the writer having positively closed valves and running at a speed of 600 ft. a minute, and from which the gear was removed for an experiment to determine the capability of the engine running at the same rate of speed without the positive valve gear. Since the removal of the valve gear the pump has been running three years with a very slight alteration in the arrangement of the valves themselves. The results have conclusively proved that high-speed pumps do not require positively closed valves and that such valves cannot be operated at more than 130 to 150 revolutions, while properly constructed poppet valves are operating at as high as 300 revolutions without showing the defects natural to poppet valves.

The type and design selected for the Ward shaft was the electric

motor and pumping engine as a whole unit. It is a well-known fact that motors designed for such slow speeds as 100 revolutions will give a very low power factor and that one of the same capacity running at 200 revolutions would give about 15 to 20 per cent. better results as regards the amount of power saved at the generating station and the reduced cost for operating, and on this basis high-speed, 200-r.p.m. pumps without mechanically-operated valves were selected. The contract, which was awarded to the International Steam Pump Company, calls for two first-motion, electrically-driven pumps, each of the units to have capacity for lifting 1,600 gallons of water per minute against a pressure equivalent to a height of 1,500 ft., or from the 3,000-ft. level up to the level of the south lateral branch of the Sutro Tunnel.

Each pump is to be driven by an 800-hp slow-speed induction motor. The contract includes column pipe, traveling crane for the pumping station, automatic oil system, a small air compressor for filling the air chambers, a small vacuum pump operated by compressed air for discharging air from the suction chamber, all the piping, valves of every description for completing the installation and a complete set of duplicate parts of the pump.

It is intended to install a temporary drainage plant at the Ward shaft, first using an air lift to lower the water to the 1,800-ft. level and thence down to the 2,500-ft. level without other pumps. The present bottom of the shaft is at the 2,500-ft. level, and when that point is reached the shaft will be sunk through the solid rock to the 3,000-ft. level, where the permanent pumps just contracted for will be installed.

A similar type of pump is shown herewith, embodying all the details of the pumps for the Ward shaft. Pumps of this type are built in capacities from 200 to 4,000 gallons per minute and for heads from 100 to 2,000 ft. The speed of the pump shown in the accompanying illustration is 300 r.p.m., the efficiency of the pump alone 95 per cent., of the motor 92 per cent., and the combined efficiency 85 per cent. The entire machine is self-contained, is mounted on a rigid box girder frame, and occupies a relatively small space. Its operation is practically noiseless under all conditions and unaccompanied by the slightest shock or heating. The weight of both pumps for the Ward shaft and their motors is about 600,000 pounds.

The Largest Electric Sign in the World.

A striking illustration of the belief of progressive business men in the effectiveness of the electric sign as an advertising medium is furnished by the new sign on the Butterick Building in New York City. The sign is placed so as to face the North River, and is visible from the Jersey shore, within a radius of several miles. An idea of the immense size of the sign can be obtained from the accompanying illustration, showing its position upon the building. It is placed so as not to obscure the working rooms. There are very few points at which it crosses the windows, and moreover the supports are only about six inches wide. The letters are 68 and 50 ft. high and the lines, inscribing them, are 5 ft. wide, the intent being to make the sign visible many miles away. They are painted in "fast black" on the bright buff of the wall. The electrical treatment is obtained by following the letter lines with a light box construction of steel, about 6 in. high, made in sections 10 ft. long, with lamp receptacles every 18 in. The box is fastened to the wall with expansion bolts, from which it stands 5 or 6 in. off to prevent clogging deposits of snow, or any serious dampening effects following heavy rainstorms.

One feature of general interest is the addition of shields to prevent the blurring of one letter by neighboring letters. In the course of several preliminary experiments it was found that at several points one line of light tended to blur with another near it, the background acting as a reflector. The shields are 6 in. wide and have bars placed on each side of the lamp line. Thus reflection is eliminated and each letter stands out in clear, sharp relief. There are 1,200 4-cp lamps controlled by three switches from as many panel boxes. One panel controls 24 circuits, the other two 16 circuits each. The wiring is carried through the interior of the sign boxes.

No special means are provided for removing the lamps. A part of the sign can be reached from the fire escapes, while to renew the other lamps a man is swung from the roof or from some of the windows in a boatswain's chair.

The sign is used five hours nightly. It is first lighted as the business day closes, remaining illuminated throughout the hours of the evening in which there is any important traffic on the North River. The daily cost is about $3—that is for electric current only—or about $1,000 annually, for which 2,000 hours of illumination are secured. The Butterick establishment is modern in every respect, the elevators, pumps, presses and all other machines being operated by direct-connected electric motors, the current for all purposes being obtained from the mains of the New York Edison Company. The engraving herewith is made from an excellent photograph taken by the photograph department of that company.

LARGE ELECTRIC SIGN.

Large Steam-Turbine Installation for Japan.

That the Japanese have not neglected industrial development while waging war is evident from the unabated activity that has continued in the electrical line. An illustration of this is an order recently given for a steam turbine installation which will be the largest in the East. The equipment has been ordered by the Tokio Electric Light Company for its Tokio power house.

The installation will consist of the following apparatus, which will be shipped from this country: Three 1,000-kw Westinghouse steam turbine outfits, the generator for which will be wound for three-phase, 50 cycles, 3,300 volts, and will operate at 1,500 r.p.m. The turbines will operate under a steam pressure of 145 pounds, with a 26-in. vacuum without superheat. The exciter outfit will consist of two separate units, the first being a 100-kw, direct-current generator, direct-connected to a Westinghouse 12 and 20 by 12-in. compound engine. The second outfit is a motor-generator set consisting of one 150-hp polyphase constant speed induction motor, wound for 3,500 volts, direct-connected to a 100-kw, direct-current generator, wound for 125 volts.

The switchboard panels and framework will be built in Japan, but the instruments for these panels will be shipped from this country and will be of standard Westinghouse make, consisting of 48 type F ammeters and 26 type F voltmeters, with necessary auxiliary apparatus.

The condensing plant is being furnished from Europe by W. H. Allen, Son & Co., Ltd., each set of units consisting of an Allen patent condenser of 3,600 sq. ft. capacity, a 13 by 10 three-throw Edwards air pump geared to an 11-hp induction motor and a 16-in. circulating pump driven by a 47-hp induction motor operating at 220 volts. The boiler outfit is being furnished by the Babcock & Wilcox Co., of London, the smaller auxiliary machinery of the plant, such as traveling cranes, feed pumps, heaters, etc., having been divided between America and Europe.

The entire installation will be strictly up to date, and will embody

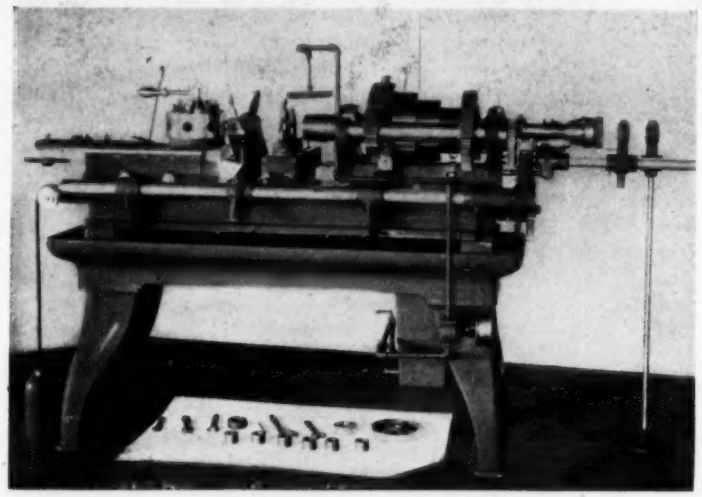
all of the latest improvements in the respective apparatus sent out. The installation was contracted by Takata & Co., Tokio, engineers and contractors, who are also preparing to ship a large consignment of electrical apparatus for the Furukawa Western Bureau, one of the largest copper mining interests in Japan.

Screw Machine With Chasing Bar.

One of the latest products of the Garvin Machine Company, of New York, is the screw machine, shown herewith, which is specially adapted for handling brass valve work, fittings, ammunition shell plugs and caps, etc., where turning, forming and thread cutting, either straight or taper, are required.

The machine is fitted with wire feed of 1 7-16 inchs capacity and 1 11-16 inches without wire feed, and provided with friction back-gearing, allowing for quick change from fast to slow speed for running on dies or heavy forming cuts. The power feed to the turret is positive by chain and gears, and a shear pin is provided to prevent injury to the machine from carelessness in setting the trip. Changes of feed are made by change gears.

The cross slide is heavy and fitted with screw feed and inside plug stops, so that forming cuts can be taken without chatter and true to size. The chasing bar provides for all needs of brass work-



SCREW MACHINE.

ing, and possesses some special features. The bar slides in bearings cast solid with the bed, and carries the chaser arm at the front end and the tool slide, which is clamped to the bar and adjustable in position. The front end of the tool slid arm carries a shoe and slides on a guide, which is adjustable vertically for taper threading. It is obvious that this attachment can be used for the turning of tapers and boring of holes when not needed for the cutting of threads.

The hobs or leaders are cut with a ratchet thread, so that the lead is not affected by the rocking out of the nut on taper work. To facilitate cutting close up to shoulders, an automatic knock-out is provided. Near the end of the hob a pin is provided, which engages a hardened block on the chaser arm as it approaches, and gives it a knock which lifts the tool out of the thread and notifies the operator to raise the tool arm clear of the work. Provision is made for cutting the leader nuts in position. The outer end of each leader has hob teeth cut on it and hardened, and the segment nut, being clamped in its place in the bar arm, is rocked over gradually against the hob teeth and cut without trouble. The weight of the machine is 1,650 lbs.

Apparatus for the Study of Radioactivity.

The accompanying illustrations indicate the attention which the Willyoung & Gibson Company, of New York, has been devoting to the development of instruments for work in radioactivity. Fig. 1 shows the Mansbendel electroscope. The system consists of a narrow strip of aluminum (not gold) leaf attached to a vertical strip, the whole being insulated by a sulphur bead. Deflections are read through opposite mica windows upon a graduated mica scale. The system is charged by a rubbed glass or rubber rod, and the insulation is so perfect that there is no appreciable change of deflection in 24 hours. The smallest bit of radioactive material placed upon the inside plate, however, causes the system instantly to drop

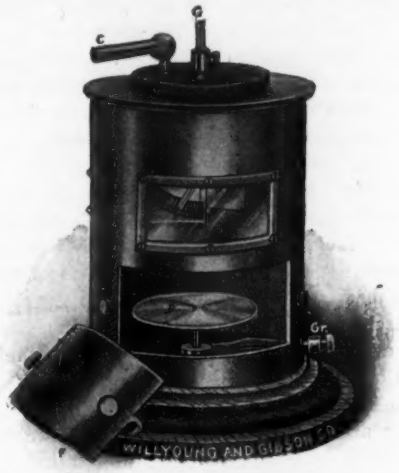


FIG. 1.—MANSBENDEL ELECTROSCOPE.

toward zero, i. e., to lose its charge. The time required for the leaf to drop completely to zero is an inverse measure of the radioactivity. An old Welsbach mantle will dissipate the entire charge in 30 to 45 seconds.

The illustration shows the first model. In the latest form of the

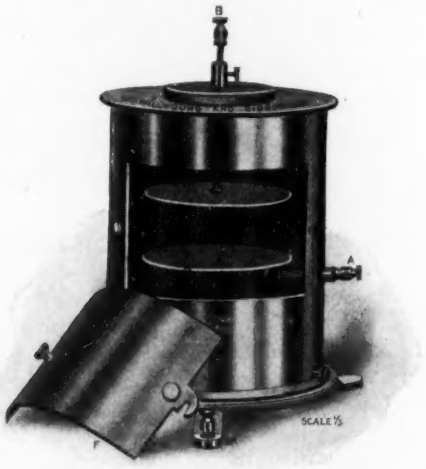


FIG. 2.—TESTING VESSEL.

instrument provision is made for attaching a plate of metal above the instrument. All of the usual classic experiments may thus be made in addition to the observations of the discharging ability of Röntgen rays, ultra-violet rays, etc.

In the use of the electroscope there is needed a vessel to contain

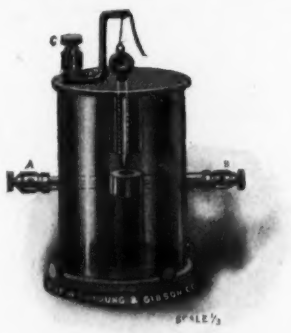
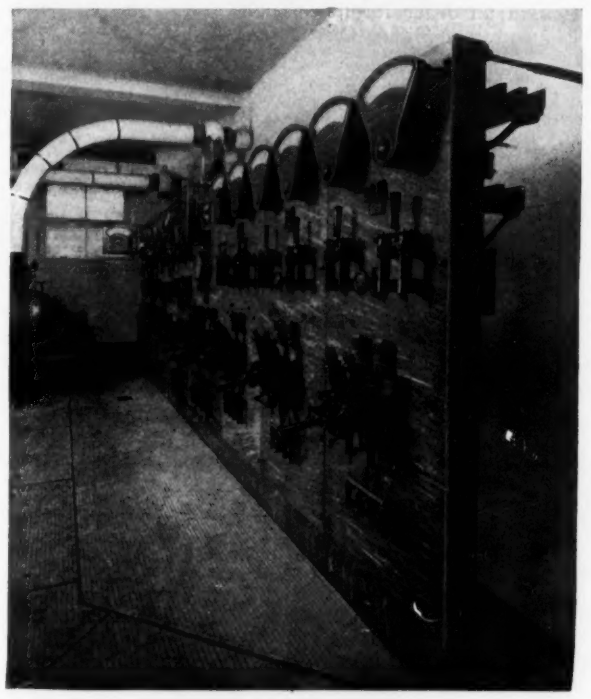


FIG. 3.—ELECTROSCOPE KEY.

the radioactive material (see "Radio-Activity," by Rutherford) and a special form of key capable of being operated from a distance. These are shown in Fig. 2 and Fig. 3, respectively.

A Compact Switchboard at Kansas City.

We illustrate herewith an excellent type of isolated plant switchboard that has recently been installed in Kansas City. The following data are furnished us by the F. Bissell Company, of Cleveland: "This Kansas City switchboard is of interest on account of its being a part of the equipment of a really modern building—one in which special attention has been paid to engineering features, maintenance of temperature throughout the entire building (summer and winter), purification of all drinking water and various special electrical innovations. The building of the John Taylor Dry Goods



FRONT VIEW OF SWITCHBOARD.

Company is a model of its kind, and is one of the best equipped mercantile buildings in the country. So far as this switchboard is concerned, it consists of three generator panels, one total load recording panel, one feeder panel and three motor control panels. The board was sold by the B. R. Electrical & Telephone Manufacturing Company to the John Taylor Dry Goods Company and was built at our Toledo factory. The strongest feature of this board is that the F. Bissell Company was called upon to furnish such a board for a large, modern, perfectly equipped mercantile building which attracts the attention of engineers and architects over the country."

Flexible Steel-Armored Hose.

The demand for a steam or air hose which could be absolutely relied upon has led the Sprague Electric Company, as a manufacturer of conduit, to enter the field with a new product which meets

FIG. 1.—VIEW OF ARMOR CONSTRUCTION.

the requirements, so that the train master, the mechanic or the quarryman can feel assured that he is safe from serious accident due to defective hose.

The Sprague Company's new product is known as "Flexible Steel-armored Hose," and consists of a suitable rubber hose encased in a steel armor which prevents expansion and thus increases greatly the life of the hose. It also protects the hose from mechanical injury and insures flexibility by making it impossible to flatten or kink when handling. In ordinary rubber hose, when overvulcanization occurs, it bursts and is immediately useless, whereas if a crack should occur through over-vulcanization in the flexible steel-armored hose, the steel armor binds the rupture so tightly that very little

FIG. 2.—COIL OF FLEXIBLE STEEL-ARMORED HOSE.

pressure is lost and the work in progress does not stop. This permits the hose to be used until a new piece can be obtained, and not only saves time but, in many cases, human lives.

The accompanying illustrations, Figs. 1 and 2, show the general appearance of the hose.

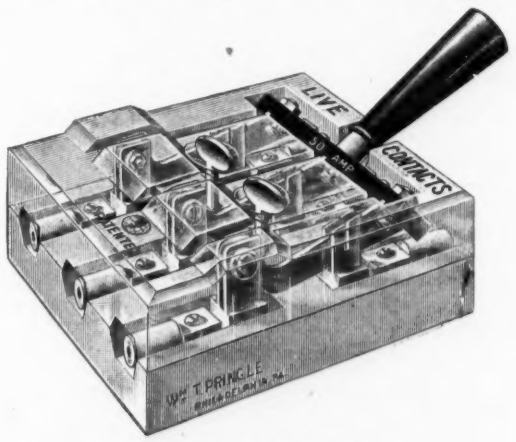
Granular Carbon from Brazil.

The International Telephone Manufacturing Company, Chicago, it is reported, has discovered, after a great amount of experimenting on various processes for manufacturing granular carbon for transmitters, that from a very hard coal secured in the southern part of the State of Sao Paulo, Brazil, and treated under a special process to polish and harden it to the greatest degree possible after granulating it to the required fineness, a carbon is produced which gives to a transmitter a much stronger and far more natural and distinct tone than any other form ever used, and avoids "frying" and "packing."

It is said that this discovery places the International Company at a great advantage in furnishing transmitters of a very efficient and durable quality, and puts it in a position where it is not dependent for its material on European manufacturers, or anyone else.

The Underwriters' Switch.

At the last meeting of the electrical section of the Franklin Institute, Mr. Devereux, of the Fire Underwriters' Association, read an interesting paper on the "Protection of Live Contacts," and among the exhibits showing the tendency of the times was a new protected switch called the "Underwriters' Switch," which is shown in the cut herewith. The metal parts of the switch are all protected with a



UNDERWRITERS' SWITCH.

porcelain cover (which does not have to be removed to operate the switch), avoiding all short-circuits due to accidental contact with live parts of the switch, and also preventing the operator from getting a shock in handling the switch. The metal parts of the switch are strong and substantial, the contacts being set in grooves to insure perfect alignment. This switch is being manufactured and placed upon the market by William T. Pringle, of Philadelphia.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Business has greatly improved in many sections of the country under the stimulating influence of better weather, spring merchandise being freely distributed by jobbers, while retail trade and mercantile collections are nearer normal. Interior buyers are placing liberal orders in the large cities and preparations for structural work are hurried. Manufacturing lines have made splendid progress since the opening of the year, especially the various divisions of the steel industry, and textile mills are well engaged. Progress is most pronounced in the iron and steel industry. A very liberal tonnage of pig iron has been purchased, indicating that confidence is increasing, and the business is well distributed, while quotations are firmly held, but not advanced as yet. Although stocks are accumulating, there is no evidence of uneasiness, for the steady increase in consumption shows that all the material will be required. Relatively, the best reports as to trade come from the central valleys and the South. The general tendency of reports as to the winter-wheat crop is that the heavy snow covering has helped the crop, which entered the winter insufficiently provided with moisture, and favorable reports in the future are predicted. Heavy rains on the Pacific coast are favorable for good crops, especially in California. The railways most affected by the winters storms are getting into shape again, and shipments are being expedited. Milder weather has helped coal shipments. Money is slightly firmer, and collections are still rather slow, being affected, at the North, by weather and snow, and at the South, by the holding back of cotton. Railway earnings are temporarily lessened and will probably run light till the effects of past and present embargoes disappear. Final reports of gross and net earnings for 1904 point to a small percentage of gain in gross receipts and to an equally slight loss in net returns from 1903. In the metal market, copper was dull and prices are unchanged. The business failures for the week ending February 23, as reported by *Bradstreet's*, numbered 220, against 243 the previous week and 200 in the corresponding week last year.

BIG OREGON WATER POWER PROJECT.—The Oregon Water Power & Railway Company is about to construct a large hydro-electric plant on the Clackamas River for the purpose of generating energy for transmission to Portland, 30 miles distant. The power will be consumed by the Portland General Electric Company (controlled by Chas. Pratt & Company, of Standard Oil interests), for lighting that west coast city and operating the electric traction system. In the first instance the capacity of the plant will be 7,500 kw, but ultimately twice that amount will be developed. Mr. W. S. Barstow, of 56 Pine Street, New York City, who acts as consulting engineer for the company, is about to consider figures on three 2,500-kw alternating current generators arranged for direct connection to water turbines. The generators will have a voltage of 11,000 which will be stepped up to 33,000 volts for the line. The Oregon Company has been financed through the Philadelphia financial house of Morris Brothers & Christensen. Mr. G. I. Brown is the chief engineer of the undertaking.

NEW ORLEANS PUMPING STATION.—Figures will very shortly be taken for the equipment to be installed in the pumping station of the New Orleans water works and filtration system. The centrifugal pumps to be installed will consist of three outfits having a capacity of 40,000,000 gallons each and one of 20,000,000 gallons capacity. The electrical equipment will include two 150-kw, 550-volt generators to be arranged for direct connection to 225-hp compound condensing engines. There will also be three 50-hp and one 30-hp motors ordered. The boiler plant will be 2,400-hp capacity in six units of 400-hp each, water tube type. Hering & Fuller, of 170 Broadway, are the consulting engineers for the installation.

BIDS FOR LOCKPORT (ILL.) TURBO-GENERATORS.—The sanitary district authorities of Chicago (Drainage Canal Commission) are now considering the question of awarding the contract for four 4,000-kw turbo-generators to two 350-kw exciter units, which are to be installed in the Lockport (Ill.) plant, where current is to be generated for transmission to Chicago for lighting purposes. Following are the bids received: Crocker-Wheeler Company, $101,366; Westinghouse interests, $114,500; Allis-Chalmers Company, $117,074; National Electric Company, $119,790; General Electric Company, $123,200, and Stanley Electric Manufacturing Company, $124,665.

MACHINE TOOLS FOR JAPAN.—Mr. Francis A. Cundill, of 90-96 Wall Street, representing L. J. Healing & Company, of Yokohama, has recently been forwarded requisitions for a large number of American labor-saving devices for shipment to Japan. The B. F. Barnes Company, of Rockford, Ill., and H. G. Barr, of Worcester, Mass., secured orders for drills. Flather & Company, of Nashua, N. H., and the Van Wyck Tool Company, of Cincinnati, O., were allotted orders for lathes. The Steptoe Shaper Company, of Cincinnati, secured an order for its specialties, and the National Machinery Company, of Tiffin, O., obtained an interesting order for bolt headers.

BULLOCK EQUIPMENT FOR CANADA.—The Huronian Company, which concern is building a large hydro-electric plant on the Spanish river, primarily for the purpose of developing energy for transmission to the Copper Cliff, Ontario, mines and smelters of the Canadian Copper Company, both of which concerns are controlled by the International Nickel Company, 43 Exchange Place, New York City, has awarded a contract to the Allis-Chalmers Company for two Bullock variable speed induction motors of 500-kw capacity each.

EQUIPMENT FOR HUDSON TUNNEL PLANT.—The Hudson Companies—the construction end of the companies, which are to operate the Jersey City, Cortlandt Street and Hoboken-Christopher Street tunnels—have placed a contract with the Heine Safety Boiler Company for four boilers aggregating about 1,500 hp for installation in the contractor's power plant of the Jersey City-Cortlandt Street section. Jacob & Davies, of 128 Broadway, are the engineers for the undertaking.

MOTORS FOR TIFFANY BUILDING.—The Crocker-Wheeler Company, through its New York offices, Mr. F. B. De Gress, manager, has been allotted the order for some thirty-five motors to be installed in the new Tiffany Building, Fifth Avenue and Thirty-seventh Street. The machines will range in capacity from 10 hp to ½ hp. They will be 115 volts, slow-speed type, and are intended for operating the machinery in the manufacturing department.

EQUIPMENT FOR PHILIPPINES.—The export and import house of Colby & Company, Corn Exchange Bank Building, is to ship some electrical equipment to the Philippine Islands for use in lighting the property of the Philippine Products Company, which proposes to develop the copra industry on a somewhat extensive scale. Later on it is expected that the company's factories near Manila will be electrically operated.

100-MILE NEVADA POWER TRANSMISSION.—The Nevada Power Mining & Milling Company is to install two 750-kw, three-phase generating outfits in its power plant, where current will be generated for transmission at 30,000 volts to the Tonopah goldfield and surrounding mining districts in Nevada. The transmission line will be about 100 miles long.

PLANT FOR MIDDLETOWN (N. Y.) SHOPS.—The New York, Ontario & Western Railroad Company has awarded contracts for the electrical plant to be installed in its Middletown (N. Y.) shops. The equipment will include two 60-kw, 250-volt, 275-r.p.m. Northern generators arranged for direct connection to Ames engines of 100 kw capacity each.

GENERATORS FOR PRINTING PLANT.—The Sprague Electric Company has secured the contract for the generators to go in the printing house plant which is being built by Street & Smith, at Seventh Avenue and Fifteenth Street. Several motors will be purchased shortly. Mr. James Robert Moore, of 156 Fifth Avenue, is the electrical engineer.

DRAWBACK ON MIRRORS.—The Secretary of the Treasury has directed that on the exportation of searchlight projectors, manufactured by the General Electric Company, of Schenectady, N. Y., with the use of imported mirrors, drawback may be allowed equal to the duties paid on the imported mirrors, less the legal deduction of 1 per cent.

PLANT FOR FIFTH AVENUE OFFICE BUILDING.—A large office building is to be constructed at 588-590 Fifth Avenue, which will have a good-sized lighting plant. Mr. Henry G. Trevor, of 15 William Street, is primarily interested in the project. Mr. A. N. Allen, 571 Fifth Avenue, has been chosen as architect.

GRAND TRUNK ELECTRIC CONTRACT.—The Grand Trunk Railway has awarded a contract to the Westinghouse Electric Manufacturing Company for electrical equipment and six electric locomotives for use in the St. Clair tunnel between Sarina, Ont., and Pt. Huron, Mich. The third rail system will be used.

ELECTRICAL GOODS IN PERU.—The Department of Commerce and Labor is indebted to the courtesy of the *New York Commercial* for the following information, received from its correspondents in Peru, relative to the duties imposed upon electric and gas equipment imported into that Republic:

Description.	Minimum valuation per 2.2 pounds.	Rate of duty.	Duty per 2.2 pounds.
	Dollars.	Per c.	Cents.
General supplies such as circuit breakers and fuses, circuit makers, keys, plugs, and electric switches of all kinds and types having china bases and tops	.60	40	24
Do. with china bases and metal tops	1.00	40	40
Do., with slate or marble bases, with or without tops	1.50	40	60
Glass insulators, gross weight	.07	40	2.8
Insulators of clay and pottery ware not over 0.03 meter in circumference, with or without pins, gross weight.	.30	40	12

COPPER FOR CHINA.—The National Conduit & Cable Company in the last issue of its admirable bulletin on the copper situation and the probability of higher prices, has the subjoined interesting statement: "Much of the copper leaving the country is booked for the Orient. The entrance of China into the market introduces a new and important factor. Chinese buyers have taken heavy shipments of copper ostensibly for coinage purposes, and the business with that country since trading began last year is reported at from 30,000 to 40,000 tons. A new customer of moment has to be considered therefore, and if China continues to make similar heavy purchases during the next six months foreign and domestic consumers may expect to feel the withdrawal of the quantities taken by China. The opening of that vast country to Western civilization is only a question of time, and with such a prospect in view there is reason to expect that in the future enormous quantities of copper will be needed in the Far East. An improvement in domestic trade will be due with the ushering in of more favorable climatic conditions in the spring, and meantime new evidences of positive strength are apparent."

BIG RIO DE JANEIRO PROJECT.—The Rio de Janeiro Tramway Light & Power Company, Limited, which was recently incorporated under the Canadian laws, with a capital of $25,000,000, for the purpose of constructing an extensive lighting and traction system in and around Rio de Janeiro, the principal city of Brazil, has acquired the concession granted in 1900 by the municipality of that South American city to local interests for the supply of electric energy generated by hydraulic force. Mr. F. S. Pearson is consulting engineer. It is expected that before long some very heavy purchases will be made for equipment, etc., here and that ere completion of the construction work the contracts to be placed here will run into figures as large as have ever been reached in this market for electrical equipment, etc., for export.

W. C. STERLING & SON.—We are advised that the firm of W. C. Sterling & Son, dealers in poles and ties, has been incorporated under the name of W. C. Sterling & Son Company, with a capital of $100,000. It is composed of W. C. Sterling, president; Walter P. Sterling, vice-president; W. C. Sterling, Jr., secretary and treasurer. The main offices and yards will be located at Monroe (Mich.), Bay City and Omer. The Bay City and Omer office and yards, as well as all the northern branches of the timber business, will be under the management of W. P. Sterling. The Monroe office, finances, sales and contracts will be managed by W. C. Sterling, Jr., at Monroe. Mr. Sterling retires from active business, and will go in for a little judicious recreation.

JALISCO HYDRO-ELECTRIC PROJECT.—Mexican advices state that the Government authorities of the State of Jalisco have granted a concession to Mr. Ramon Agraz Palmorea, a civil engineer, of Mascota, which permits of the construction of a large hydro-electric plant at the juncture of the Hascota and Agostadero rivers. The power will be transmitted to the city of Mascota principally for lighting and general industrial purposes. Contracts have also been made for the supply of current to manufacturing plants in the vicinity.

BUFFALO ELECTRIC PUMP ORDERS.—The Buffalo (N. Y.) Steam Pump Company has secured a contract for a large duplex horizontal electrically driven power pumping equipment to be installed in the Schlitz Brewing Company's plant at Milwaukee, Wis. Several outfits of different sizes have been ordered by the International Salt Company for its various plants. Export orders have also been recently secured from London, England; Rio Janeiro, Brazil and Sydney, Australia.

TROLLEY DEVELOPMENT IN BROOKLYN.—As already stated a large amount of money is to be spent on electric railway work in Brooklyn. President Winter, of the Brooklyn Rapid Transit system, announces that about $1,000,000 of the $2,500,000 to be spent on improvements on that system will be used in the purchase of new cars. The new equipment will include about 200 surface cars and 150 cars for the elevated.

THE AMERICAN CONDUIT MANUFACTURING COMPANY is making extensive additions to its plant in New Kensington, Pa. When these are completed its manufacturing facilities will be increased 100 per cent. The sale of American steel conduit has steadily increased until the remodeling of the plant has become an absolute necessity. The offices of the company are located at 524 Fourth Avenue, Pittsburg, Pa.

EQUIPMENT FOR NEW BABBITT PLANT.—The new plant to be constructed at Granton, N. J., by the B. T. Babbitt Soap Company, 64-84 Washington Street, will be electrically operated. There will be two 150-kw. generators arranged for direct connection to 250-hp. engines. Several motors will also be contracted for. Mr. C. W. Aiken, the engineer of the company, will have charge of the work.

THE OSAKA ELECTRIC LIGHT COMPANY, of Osaka, Japan, has awarded the coming year's contract for incandescent lamps, amounting to 100,000 lamps, to the Japanese engineering and contracting firm of Takata & Company, Tokio, Japan, having New York offices at No. 10 Wall Street, New York City. Takata & Company have ordered these lamps from the Sawyer-Man Electric Company.

HALL SIGNAL CONTRACT.—A contract has been awarded the Hall Signal Company by the Chicago & Northwestern Railroad Company for the equipment of its line between Milwaukee and Lake Shore Junction with the Hall automatic electric disc signals.

MACHINE TOOLS FOR ENGLAND.—P. Blaisdell & Co., of Worcester, Mass., have secured the largest export order hitherto received by them for lathes. The machines are to be shipped to England with all dispatch.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was active speculation on the stock market, the public seeming to take more interest in stocks than it has lately. Union Pacific and the Southern iron groups were the principal centres of activity, and at the same time new record prices were made in many cases. The market was irregularly strong, and there was an excellent demand for investments. The United States Steel stocks were the objects of another upward movement which did not hold entirely, but was favorable in its effects upon other industrials. The traction and electric securities were irregular, some showing gains on the week's business, while others went the other way. The gains are in American Telephone & Telegraph, 2⅛ points, closing at 147; Electric Storage Battery (now quoted on the New York Stock Exchange), 4⅜ points, closing at 88; General Electric, ¼ point, the closing price being 187; New York & New Jersey Telephone, 2¾ points, last price 171¼; Westinghouse, common, 2½ points, the closing quotation being 180½, and Brooklyn Rapid Transit, 1⅛, closing at 63⅜. The stocks on the losing side were: Allis-Chalmers, common and preferred, ¼ and 1 respectively, the closing quotations being 17¾ and 66; Metropolitan Street Railway, ⅞, closing at 120½, and Westinghouse preferred, 2½, the last quotation being 180½. Western Union is unchanged at 93⅜. The curb market was irregular, but advances predominated. Interborough Rapid Transit took a sharp downward turn and dropped from 216, the highest quotation of the week, to 201, but rallied somewhat and closed at 205, a net loss of 9½ points. Following are the closing quotations of February 28:

NEW YORK

	Feb. 20	Feb. 28		Feb. 20	Feb. 28
Allis-Chalmers Co.	17⅝	17¼	Electric Vehicle	14	14
Allis-Chalmers Co. pfd.	65¼	63	Electric Vehicle pfd.	22	22
American Tel. & Cable.	94	93	General Electric.	186	186¼
American Tel. & Tel.	144½	144	Hudson River Tel.	..	..
American Dist. Tel.	32	33	Interborough Rap. Tran.	209	203¼
Brooklyn Rapid Transit.	62⅜	64⅜	Metropolitan St. Ry.	120⅜	120⅝
Commercial Cable.	..	..	N. Y. & N. J Tel.	..	..
Electric Boat	39½	40	Marconi Tel.	..	..
Electric Boat pfd.	79	79	Western Union Tel.	93¼	93⅜
Electric Lead Reduction.	¼	¼	Westinghouse com	178	181
			Westinghouse pfd	190	187½

BOSTON

	Feb. 20	Feb. 28		Feb. 20	Feb. 28
American Tel. & Tel.	145	144½	Western Tel. & Tel. pfd.	102	102*
Cumberland Telephone.	121	120	Mexican Telephone.	1¼	1⅛
Edison Elec. Illum.	251	251	New England Telephone.	*134½	136
General Electric.	186	187	Mass. Elec. Ry.	13¼	14
Western Tel. & Tel.	20⅝	*21	Mass. Elec Ry. pfd.	57	57

PHILADELPHIA

	F-b. 20	Feb. 28		Feb. 20	Feb. 28
American Railways	50½	52¼	Phila. Traction.	101	101
Elec. Storage Battery.	84¼	88	Phila. Electric.	10⅝	10⅝
Elec. Storage Battery pfd.	..	..	Phila. Rapid Trans.	30	31
Elec. Co. of America.	12¼	11⅞			

CHICAGO

	Feb. 20	Feb. 28		Feb. 20	Feb. 2
Central Union Tel.	..	..	National Carbon pfd.	113	113
Chicago Edison.	172	170	Metropolitan Elev. com.	20	20½
Chicago City Ry.	..	..	Union Traction.	..	..
Chicago Tel. Co.	..	142	Union Traction pfd.	..	..
National Carbon.	43	43			

* Asked.

MONTEREY ELECTRIC & GAS COMPANY.—The Monterey Electric & Gas Company has been incorporated under the Canadian laws, with a capital of $3,000,000, for the purpose of conducting an extensive electric lighting and traction business in and around Monterey, the capital of Nuevo Leon, Mexico, and one of the most important manufacturing cities in the southern republic. Interests, largely identified with the powerful Canadian syndicate, which is primarily concerned in the Sao Paulo (Brazil) Tramway Light & Power Company, the Havana (Cuba) Electric Railway Company, the West India Electric Company, Limited, of Kingston, Jamaica; the Trinidad Electric Company, of Port au Spain, Trinidad, British West Indies; the Mexican Light & Power Company, Limited, and the Rio Janeiro (Brazil) Tramway Light & Power Company, Limited, are behind the new enterprise. The incorporators of the company are Mr. William Mackenzie, who is president of the Toronto Railway Company, the Sao Paulo Tramway Light & Power Company, and Mr. William Laidlaw, Z. A. Lash and A. W. Mack, all of Toronto, and Mr. H. S. Holt, of Montreal. Negotiations are now being conducted with the Monterey Light & Power Company, Limited, regarding the taking over of that concern's property by the Canadian company. The Monterey Light & Power Company operates an extensive lighting system in Monterey. The company is controlled by J. G. White & Company and H. W. Halsey & Company, of New York, Mr. P. G. Gossler, vice-president of J. G. White & Company, being president of the company, while Mr. H. R. Tobey, of the Halsey banking house, acts as secretary and treasurer. The chief engineer of the company is Mr. Emilio Dysterud. The capital of the company is $500,000. The Canadian company has already contracted for the purchase of the existing horse car lines in Monterey, and what is known as the Mackin & Dillon concession, originally granted to the American contracting concern of that name. The purchase price is $450,000 gold. Thirty miles of electric road will be built in the first instance and construction will begin, it is expected, inside of the next thirty days. Mr. Keating, of Toronto, will have charge of the work.

NEW YORK & NEW JERSEY TELEPHONE.—The New York & New Jersey Telephone Company has issued its full pamphlet report for the year ended December 31, 1904. The income account compares as follows:

	1904.	1903.	1902.
Gross	$5,393,709	$4,741,344	$3,962,597
Expenses	3,729,335	3,269,996	2,823,458
Net	$1,664,374	$1,471,348	$1,139,139
Charges and taxes	187,422	181,214	166,350
Surplus	$1,476,952	$1,290,134	$972,789
Dividends	962,089	852,216	707,627
Surplus	$514,863	$437,918	$265,162

The surplus after charges and taxes for the year amounted to $1,476,952 and is equal to 10.61 per cent. earned on the $13,917,600 capital stock. The earnings and expenses in detail for the past three years were as follows:

Gross:	1904.	1903.	1902.
Exchange service	$2,601,024	$2,262,289	$1,908,707
Pay stations	703,017	596,031	490,294
Tolls	1,820,280	1,656,943	1,365,854
Leased lines and instruments	24,652	23,730	.....
Real estate	161,068	132,803	113,415
Other sources	83,668	69,547	89,327
Total	$5,393,709	$4,741,344	$3,962,547
Expenses:			
General	$844,576	$761,541	$646,240
Operating	923,412	761,331	594,730
Maintenance and reconstruction	1,601,793	1,446,050	1,330,172
Instrument rent	250,681	219,950	181,616
Real estate	108,873	81,124	70,699
Total	$3,729,373	$3,269,996	$2,823,457

ST. LOUIS ELECTRICAL SITUATION.—Mr. John I. Beggs, of the North American Company, has been in St. Louis, inspecting the lighting properties of which he is president. Mr. Beggs gave *The Wall Street Journal* the following concise, exact and formal presentation of the facts in regard to the present status of the deal for the absorption of the United Railways Company of St. Louis properties by his corporation: "There is a difference of $625,000 between the price we offered and the figure Brown Brothers & Co. and their associates want. Whether this will result in the deal being dropped, is not certain. They ask $25 per share for United Railways common and guaranty of 1 per cent. on the preferred. To neither of these propositions has the North American Company assented. That is the situation to-day. What may develop I do not care to forecast. We stand ready to close the deal at any time at our price. They are holding out for their valuation and their proposition. Much depends on what happens in New York."

DIVIDENDS.—The directors of Butte Electric & Power Company have declared a dividend of 3 per cent. upon the common stock out of the surplus earnings of the company for the year 1904, payable as follows: $1.50 per share on March 15 to stockholders of record on March 11 and $1.50 per share on September 15 to stockholders of record on September 11.

AMERICAN TELEPHONE BONDS.—Advices from Boston say: "The decision of the American Telephone & Telegraph directors to issue 4 per cent. bonds was arrived at after mature consideration of all the plans suggested. The American Telephone Company believe their credit is still good for a 4 per cent. bond, and will accordingly receive bids until March 1 for $25,000,000 4 per cent. bonds due in 1929, which is the maturity of the present outstanding $28,000,000 4s. An official of the company says: "I do not believe the company will have any difficulty in selling an issue of $25,000,000 4 per cent. bonds. The present outstanding bonds are selling at 94, or on a 4¼ per cent. basis, and if the new bonds are sold at 94 or better it means that on an issue of $25,000,000 we are saving for stockholders $800,000 per annum as compared with what we would have to pay in 7½ per cent. dividends on a new stock issue. The new bonds are a gilt-edge investment, secured by the deposit of subcompany stocks in our treasury, with an additional margin of 33⅓ per cent."

PHILADELPHIA BELL TELEPHONE.—The Bell Telephone, of Philadelphia, has held its annual meeting. Charles F. Cutler, chairman, and the board of directors were re-elected. The earnings for the year aggregated $3,756,059.79, of which $3,538,654.39 was derived from exchange and toll service. According to the report, the cost of operation was $2,810,803, and the net earnings amounted to $945,256.79. Dividends amounting to $836,010 were declared, and a balance of $109,246.79 was placed to the surplus account. The management spent $1,631,647.74 for improvement and equipment. The company had 82,497 stations in service on January 1 last, an increase of 15,229 over the same time last year. It is the management's intention to increase this number by 27,000 in the coming year.

DEAL IN BUFFALO TROLLEYS.—It is announced from Buffalo that Henry J. Pierce, of that city, and Nelson Robinson, a New York capitalist, and their friends have bought control of the International Traction Company, which is the holding company of the International Railway Company. It is understood that Mr. Pierce will succeed W. Caryl Ely as president. The International Railway Company was organized February 20, 1902, when it took over the property of the old local company and also the Buffalo and Niagara Falls and other suburban lines. W. Caryl Ely, formerly of Niagara Falls, was elected president, and has continued in that office down to the present. Mr. Pierce is the president of the Chamber of Commerce and has very influential Standard Oil connections.

MILWAUKEE ELECTRIC LIGHTING.—The increase of $500,000 in the capital stock of the Milwaukee Light, Heat & Traction Company, which is controlled by the Milwaukee Electric Railway & Light Company, the latter being a sub-company of the North American Company, has been made in order to effect desired improvements. All this new stock will be bought by the Milwaukee Electric Railway & Light Co., whose finances are in an excellent condition. The Milwaukee Light, Heat & Traction Company operates between Milwaukee and surrounding towns, and the possibilities for increasing business in both the railway and the lighting enterprises in the company's territory are regarded as very great.

NORTH AMERICAN NEW STOCK.—The New York Stock Exchange has been notified that the North American Company proposes to issue $13,000,000 additional stock. About $5,000,000 will be used to take over the minority stock of the Laclede Gas Light Company and the United Electric Company, of St. Louis, and it is understood the balance will remain in the treasury to be used as the directors may deem advisable. With the additional issue the total outstanding will be $30,000,000.

BIG TELEPHONE TRUST DEED.—A trust deed on all the property of the Independent Consolidated Telephone Company, to secure an issue of $70,000,000 of bonds running to the Milwaukee Trust Company, has been filed in Milwaukee. The deed is subject to a mortgage given on June 1, 1904, to the Milwaukee Trust Company to secure a $40,000,000 issue of bonds by the Union Telephone Company, which were assumed by the Consolidated Telephone Company.

MISSOURI AND KANSAS BELL.—The report of the Missouri & Kansas Bell Telephone Company for the year ended December 31 is as follows:

	1904.	1903.	Changes.
Gross	$1,328,324	$1,303,795	Inc. $24,529
Net	245,868	300,077	Dec. 54,209
Deficiency after interest and dividend	47,752	*64,903	Inc. 112,655

*Surplus.

MONTGOMERY TRACTION DEFAULT.—The Montgomery Traction Company, of Montgomery, Ala., has been placed in the hands of a receiver on the petition of the North American Trust Company, of New York, in default of payment of the interest on $400,000.

INCREASE OF CAPITAL.—At the recent meeting of the stockholders the capital stock of the Milwaukee Light, Heat & Traction Company was increased from $500,000 to $1,000,000.

General News of the Week

The Telephone.

YELLVILLE, ARK.—The Yellville Telephone Company has been given a charter. The capital stock is $150,000, all subscribed. The corporators are V. H. Weart, L. M. Weart, S. L. Brooksher, R. R. Brooksher and G. A. Ward.

ROGERS CITY, ARIZ.—The Rogers City Council has granted a 20-year franchise to the Central Telephone Company.

BURLINGTON, COL.—The Burlington Telephone Company, capital $1000, has been formed by D. Caracahan, C. D. Gillette and others.

KIRKSVILLE, ILL.—The Kirksville Mutual Telephone Company has been incorporated with a capital stock of $2400. The incorporators are O. M. Hale, E. R. Boggs and others.

STREATOR, ILL.—The Independent Telephone Company will expend $15,000 for new construction in this place this year. The company has already invested $130,000 in this city and now have about 1400 subscribers.

KANKAKEE, ILL.—Christenson Bros., who have owned and operated the St. Anne Telephone exchange for the past two years, have sold out their interest to the Central Union Telephone Company with district headquarters at Kankakee.

FULTON, IND.—The Fulton Telephone Company has increased its capital stock and will increase its switchboard capacity from 150 to 250 telephones.

HUNTINGTON, IND.—The Central Union Telephone Company will establish an exchange in this city.

ELIZAVILLE, IND.—The Elizaville Telephone Company has increased its capital stock in order to install new equipment and extend the lines so as to take care of the rapidly increasing business.

LAPORTE, IND.—The Laporte Telephone Company will increase its capital stock from $30,000 to $60,000 for extensions and betterments. J. V. Dorland is president and P. O. Dorland, secretary.

AURORA, IND.—At a recent meeting of the Aurora Mutual Telephone Company the following-named officers were elected: President, D. E. Clements; secretary and treasurer, C. A. Zeh; trustees, R. A. Sawdon, G. L. Baker and H. N. Christy.

SOUTH BEND, IND.—The South Bend Home Telephone Company, which began operation two years ago, in opposition to the Central Union, now has 3500 telephones and has just decided to put in an automatic system, the first to be used in Indiana.

INDIANAPOLIS, IND.—An amendment to the codification bill has been adopted by the Senate which takes away from cities and towns the right to regulate telephone and telegraph companies and places them in a class with transportation companies.

SALAMONIA, IND.—The Salamonia Telephone Company has increased its capital stock from $2500 to $10,000 for the purpose of making improvements, extending the lines and increasing the capacity of the switchboard. J. J. Kidder is president and J. W. Cull, secretary.

CRAWFORDSVILLE, IND.—The Central Union Telephone Company has entered the country districts and effected reciprocal arrangements with a number of co-operative lines in Montgomery and adjacent counties. This move is regarded with concern by the independent companies.

SHELDON, IA.—The Sheldon Telephone Company has been formed, capital $1500. G. A. Starrett and others are the incorporators.

ALTA VISTA, IA.—Articles of incorporation have been filed with the Secretary of State by the Alta Vista Farmers' Telephone Company with a capital of $2500.

KAHOKA, IA.—The Hubinger telephone system is now in the hands of a receiver. By order of Circuit Judge Charles D. Stewart, E. Hitt Stewart, of Kahoka has been appointed receiver.

ATLANTIC, IA.—A number of farmers north of town, among them being William Lamb, A. Pellett, D. E. Milford, Charles Bartley and O. M. Becker, have organized what they propose calling the Atlantic Mutual Telephone Company.

DECORAH, IA.—The Winnishiek Co-operative Telephone Company, recently incorporated, will build a system in Decorah during the coming summer, and will need a supply of cedar poles, wires, cables, etc. Address L. L. Iverson, Decorah.

SWISHER, IA.—The Midway Switch & Telephone Company has been incorporated here. The capital stock is $10,000. The first officers are: President, S. A. Dean; vice-president, H. Hanson; treasurer, Wesley Novotny; secretary, M. H. Eaton.

TOPEKA, KAN.—The Woodson Mutual Telephone Company has been incorporated; capital $4000.

BOWLING GREEN, KY.—The stockholders of the Home Telephone Company have elected the following officers: I. F. Beard, of Huntington, Ind., president; E. B. Stout, first vice-president; W. B. Mayes, second vice-president; J. Whit Potter, treasurer; Hubert Myers, secretary; W. I. Allison, general manager.

BETHEL, ME.—The Middle Intervale Telephone Company has been formed with a capital of $1000. President: O. A. Buck; treasurer, C. C. Bryant, both of Bethel.

BANGOR, ME.—The Bangor Automatic Telephone Company will install an exchange in this city, the capacity of which will be 10,000 instruments, although but 2000 wil be put in at present. The work will include underground conduits and will be done by the Maine Construction Company.

GREENVILLE, ME.—The Greenville and Kennebec Telephone & Telegraph Company has been organized at Greenville with $10,000 capital stock, of which nothing is paid in. The officers are: President, Charles D. Shaw, of Greenville; treasurer, Henry M. Shaw, of Greenville.

BALTIMORE, MD.—At a meeting of the directors of the Maryland Telephone Company Mr. H. W. Webb, vice-president, was elected president, succeeding Mr. David E. Evans. Mr. Evans continues with the company as vice-president, though he will devote his time to the Baltimore Electric Company, which is building a large lighting plant in South Baltimore. Mr. W. T. Spring was elected secretary of the Maryland Telephone Company.

WORCESTER, MASS.—The Farmers' Exchange Telephone Company has been incorporated with a capital stock of $125,000. The incorporators are E. R. Culver, J. C. Fixler, H. F. Rickert, C. C. Kendig and Dayton J. Eddy. The following officers were elected: President, H. F. Rickert; vice-president, J C. Fixler; secretary and treasurer, E. R. Culver.

BENZONIA, MICH.—At the annual meeting of the stockholders of the Benzie County Telephone Company W. A. Young was re-elected president; Geo. C. Woodward, vice-president, and H. B. Woodward, secretary and treasurer. It was voted to increase the capital stock from $50,000 to $100,000.

MONROE, MICH.—The Stoddard-Osgood Telephone Company has recorded articles of incorporation with the County Clerk, under the provisions of the franchise granted by the city to the Stoddard Telephone Construction Company, July 1, 1901, the rights and privileges being assigned to the Stoddard Company. The capital stock is $10,000. The line runs from Monroe to the southern part of the county, and connects with Toledo.

HECTOR, MINN.—A local telephone company is to be formed. John Hokanson is interested.

PEQUOT, MINN.—The Cass County Telephone Company is being organized at Pequot, Cass County, to erect farmers' lines.

ALBERT LEA, MINN.—The Manchester Farmers' Telephone Company will build a line from Hartland to Manchester and Albert Lea.

MINNEAPOLIS, MINN.—The Bellingham Telephone Company has been chartered, capital stock $25,000. Incorporated by Lucius F. Clark and Fred J. Rosenwald.

GRAND MEADOW, MINN.—The Home Telephone Company of Grand Meadow has been formed; capital stock, $50,000; incorporators, C. F. Greening, W. A. Nolan, Martin Axness and W. P. Lewis, of Grand Meadow.

NATCHEZ, MISS.—The Clay County Telephone Company has been formed, capital $100. Incorporated by J. W. Coleman and others.

JACKSON, MISS.—The Yazoo Telephone & Telegraph Company has reduced its rates to $2.25 per month for business telephones, instead of $2.50 as heretofore, and residence telephones are reduced from $1.50 to $1.25 per month.

LEWISTOWN, MONT.—The Lewistown & Billings Mutual Telephone Company has been incorporated with $20,000 capital stock.

FORSYTHE, MONT.—A franchise has been granted to J. E. Edwards to operate and maintain a telephone system in Forsythe.

PLATTSMOUTH, NEB.—At the annual meeting of the Plattsmouth Telephone Company the following officers were elected: President, T. E. Parmele; vice-president, C. C. Parmele; treasurer and general manager, T. H. Pollock; secretary, J. N. Wise.

MONDAMIN, NEB.—At the annual meeting of the Interstate Telephone Company of Harrison County, the following officers were elected for the ensuing year: W. A. Smith, president; A. Spooner, vice-president; C. J. Cutler, secretary; John Young, manager; H. M. Sibsby, treasurer.

WILSONVILLE, NEB.—The Inter-State Telephone Company, with a capital of $10,000, has been incorporated by A. W. Hunt, E. W. Parker, C. W. McComb, F. B. Johnson and T. H. Shoemaker.

CHESTER, N. J.—The Chester Local Telephone Company is making preparations to extend its line to Gladstone, Ralston and Parker.

WHITEHOUSE, N. J.—The Lebanon Telephone Company will be incorporated with a capital increased from $5100 to $25,000. It proposes to operate its lines throughout the whole state.

CHURCHVILLE, N. Y.—A franchise has been granted to the Churchville Home Telephone & Telegraph Company. Mr. M. J. Burton is one of the incorporators.

CAIRO, N. Y.—At the meeting of the stockholders of the Catskill Mountain Telephone Company, held in this village, the capital stock of the company was increased from $15,000 to $30,000.

CANDOR, N. Y.—The Candor Telephone Company has been formed, capital $2500. Incorporators: J. W. McCarty, H. D. Heath and J. P. Fieberg, all of Candor, Tioga County, N. Y.

ALBANY, N. Y.—The New York Independent Telephone Company has been incorporated to operate in New York City to Boston, Albany, Jersey City, Philadelphia, and other places in the States of New York, Massachusetts, Rhode Island, Connecticut, New Jersey and Pennsylvania. The capital stock of the company is $50,000, and the names of the directors are O. S. Lee, Jr., J. M. Woods and B. S. Mantz, New York.

GRANVILLE, N. D.—O. G. Nordmarken and others have been granted a franchise for a telephone and electric light system.

BLOOMER, OHIO.—The Bloomer Home Telephone Company, capital $1000, has filed a certificate of incorporation.

WATERTOWN, OHIO.—The Barlow & Watertown Telephone Company has certified to an increase of capital from $10,000 to $15,000.

BATAVIA, OHIO.—The New Citizens Telephone Company has been formed by B. W. Gilfillan and others, capital $150,000.

PORTERSVILLE, OHIO.—The Triadelphia-Sayer Company has been formed with a capital of $500, by B. J. Petit, M. R. Hearing and others.

WARREN, OHIO.—The Champion Telephone Company has just been organized here. C. J. Chinnock is president and L. W. Pierce, secretary-treasurer.

DANVILLE, OHIO.—The Mt. Vernon Telephone Company has just completed the construction of a new and up-to-date telephone exchange at Danville. The sum of $15,000 has been expended.

SALEM, OHIO.—At the annual meeting of the Columbiana County Telephone company, officers were elected as follows: President, F. S. Dickson, of Cleveland; vice-president, W. C. Morron, of Lisbon; secretary, James B. Hoge, of Cleveland; treasurer, R. W. Judd, of Cleveland.

FREMONT, OHIO.—At the annual meeting of the Fremont Home Telephone Company the directors elected: President, S. Brinkerhoff; vice-president, C. M. Russell; secretary, Joseph Horn; treasurer, J. M. Sherman. The company added 357 new telephones during the year and now has 1300 telephones connected.

DECATUR, OHIO.—Chas. Grimes, Dr. Hamilton and J. B. Rogers have sold their telephone line from Decatur to Russellville to the Home Company.

WARREN, OHIO.—A number of co-operative telephone companies are being formed by the citizens of Greene, Gustavus, North Bloomfield, Bristol, Champion, a condition brought about in part by dissatisfaction of poor service given by the company that serves that territory. The Waren & Niles Telephone Company, whose working agreement has expired with the Warren & Jefferson Company, is backing the co-operatives.

CINCINNATI, OHIO.—The board of directors of the City and Suburban Telephone Company has authorized the purchase of several outside telephone lines which, needing financial assistance, appealed to the Cincinnati Company. As the question of the capital stock which will be issued to pay for the new property still remains to be passed on by the stockholders, the identity of the corporation will not be made public until the stockholders have voted on the increase.

BYRON, OKLA.—A charter has been issued to the Byron Rural Telephone Company with a capital stock of $1000. The telephone line is to run between Mendon and Byron. The incorporators are H. B. Holderby, M. Sluder and W. M. McRay, all of Byron, Okla.

WILLIAMSPORT, PA.—A movement is reported on foot to organize a new telephone company, with a capital stock of about $10,000 to build a telephone line between Williamsport and Roaring Branch, a distance of 27 miles. It is also stated that the new line will connect with the United Telephone exchange at Newberry.

PHILADELPHIA, PA.—Richard G. Park was elected president of the United Telephone & Telegraph Company at the annual meeting. W. D. Barnard was chosen vice-president and S. B. Caldwell, secretary and treasurer. The treasurer's report showed that the gross income was $464,249.03 and the net earnings $25,444.04.

PIEDMONT, TENN.—The Piedmont Telephone Company has been organized here. The following are the officers: Dr. William R. West, general manager; W. M. Brooks, secretary.

ORANGE, TEX.—The Orange-Newton Telephone & Telegraph Company is being organized. The capital stock is to be $2500 at the beginning and will be increased later. The directors of the company are E. R. Webber, A. M. H. Stark, Dr. E. W. Brown, F. H. Farwell, all of Orange, and C. W. Emmer, of Beaumont.

BUFFALO, VA.—The Winfield, Buffalo & Gallipolis Telephone Company has been incorporated with a capital stock of $15,000. The incorporators are E. B. Hensen, S. V. Handley and others.

RICHMOND, VA.—The Southern Bell Telephone & Telegraph Company has been granted a charter by the State corporation commission of Virginia to conduct a telephone and telegraph business, with a maximum capital of $200,000. W. T. Gentry, of Richmond, is president.

MINDORA, WIS.—The La Crosse County Telephone Company will install an exchange in this city.

DOWNSVILLE, WIS.—The Downsville Telephone Company has been formed by J. F. Denham and others, capital $3500.

RETREAT, WIS.—The Vernon County Telephone Company has been incorporated with a capital of $5000. The incorporators are F. V. Evert and W. C. Morgan.

MAPLEHURST, WIS.—The Withee and Maplehurst Telephone Company has been chartered, capital $1000. Incorporated by Wallace D. Clemons, John Christenson and others.

RACINE, WIS.—The Citizens' Telephone Company will shortly erect a modern exchange building, in which will be installed an automatic system at an expense of $150,000. The company is about to place on the market $200,000 of its bonds.

OTTAWA, ONT.—The Northwest Telephone Company's bill for incorporation has been reported on favorably to Dominion Parliament. The capital stock is placed at $500,000. The head office is to be located in the city of Winnipeg, Man.

TORONTO, ONT.—The Scarboro Telephone Company and the Markham & Pickering Telephone Company have incorporated by the Ontario government. The capitalization of the Scarboro Company is to be $40,000 with the head office in Toronto, Ont.

Electric Light and Power.

GREENVILLE, ALA.—The City Council has granted the C. C. Henderson Electric Light Company a franchise for an electric light plant.

DOTHEN, ALA.—This city is contemplating installing a 250-kw revolving field alternator, a 375-hp engine, and changing the circuits (except power) from direct to alternating current and installing 50 series enclosed arcs. W. E. Culver is superintendent.

SAN FRANCISCO, CAL.—The Eel River Power & Irrigation Company has been incorporated, with a capital stock of $500,000, by H. B. Muir, of Willets, R. E. Donohue and W. P. Thomas, of Ukiah; F. D. Madison and W. W. Van Arsdale.

FRESNO, CAL.—The San Joaquin Power Company, Fresno, Cal., will construct at once a 3000-hp power plant near Crane Valley, about 50 miles from Fresno. S. A. Butler is purchasing agent, Pacific Electric Building, Los Angeles, Cal.

SAN FRANCISCO, CAL.—Manager Jilson of the Gladstone Mining Company at French Gulch, Shasta County, Cal., will install additional electric generating equipment having a capacity of about 150 kilowatts. The new plant will be located about a mile below the present plant, which includes a 200-kw Stanley 3-phase generator direct connected to a water wheel and transmits current 10 miles at 6600 volts.

SAN FRANCISCO, CAL.—The Mutual Electric Light Company, which has just completed its second electric light and power plant in this city, has filed with the Supervisors a financial statement covering the year 1904. It is shown that the company's revenue amounted to $116,416.71; expenses, $94,967.63. The original cost of the plant is stated as $479,787.27, but the company reports that its present value is impossible to estimate. The capitalization is $500,000 in shares of $10 each, and 41,250 shares have been issued. The outstanding bonds amount to $193,000 and the floating indebtedness to $10,478.58.

SAN FRANCISCO, CAL.—It is understood that the Southern Pacific Company, in planning to establish electric lighting plants along its main line in the State of Nevada, has taken into consideration the possibility of introducing electric traction on the division between Sacramento, Cal., and Reno, Nev. It is reported that electric plants will be installed at Winnemucca, Reno and Blue Canyon and at other points suitable for electric distribution between San Francisco and Nevada. It is estimated that the expenses for oil and extra labor for lighting stations and signals can be reduced by electric lighting from central stations.

AQUILAR, COL.—A company is about to be formed by A. R. Lindsey, Morris Pitti and others to construct an electric light plant at a cost of about $10,000.

EMPIRE, COL.—W. P. Clough, of Empire, is reported interested in the Clear Creek County Power & Irrigation Company which proposes constructing a water power plant for the generation of electricity for mining and irrigation.

TORRINGTON, CONN.—At a meeting of the directors of the Torrington Electric Light Company, the following officers were elected: President, George D. Workman; treasurer, Frank M. Travis; secretary, Frederick F. Fuessenich.

GLASTONBURY, CONN.—It is stated that work will begin, as soon as weather permits, on the construction of a power house and dam for the Glastonbury Power Company. The probable cost of this work will be $175,000. Jas|. S. Williams is president, Lewis W. Ripley, secretary, both of Glastonbury.

WILMINGTON, DEL.—The Everett Railway, Light & Water Company, of Everett, Wash., has been incorporated here with a capital stock of $2,000,000.

TIFTON, GA.—The Tifton Ice & Power Company will install a new engine and dynamo. S. M. Roberts is manager.

WASHINGTON, D. C.—Bids will be received March 14 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing at the navy yards, Mare Island, Cal., and Puget Sound, Wash., a quantity of electrical wire, incandescent lamps, electrical cable, etc. H. T. B. Harris, Paymaster-General, U. S. N.

COEUR D'ALENE, IDA.—The Spokane Traction Company, Spokane, Wash., will erect a $700,000 power plant at Cœur D'Alene. Jay P. Graves is president.

POST FALLS, IDA.—The Washington Water Power Company, Spokane, Wash., is erecting a power house at Post Falls, Ida., and has closed contracts with the Platt Iron Works Company for 6000 horse-power in turbines and with the General Electric Company for the electrical machinery, including switchboards. D. L. Huntington is general manager.

STONINGTON, ILL.—L. D. Hewitt is interested in the construction of an electric light plant.

VERMONT, ILL.—The city will purchase a dynamo for the electric light plant. E. L. Durrell is manager.

LEBANON, ILL.—It is proposed to install at the city light plant a dynamo and engine and build a new smoke stack.

MONMOUTH, ILL.—The Monmouth Gas & Electric Company is preparing plans for an extension to the electric light plant.

FAIRBURY, ILL.—The capital of the Fairbury Electric Light & Power Company has been increased from $12,000 to $30,000.

LOCKPORT, ILL.—Bids will be received by the Trustees of the Sanitary District of Chicago, April 12, for the construction of a power house for the Lockport power development near Lockport, on the extension of the main drainage channel. Z. R. Carter is president.

ZION CITY, ILL.—The Zion Building & Manufacturing Association contemplates installing a 500-hp engine direct connected to a 300-kw 3-phase 60 cycle General Electric generator, a motor-generator set, one 100-kw 3 phase 60 cycle General Electric machine, a switchboard of 11 panels, two 250-hp boilers of the Cahall type and a series alternating street lighting system. Burton C. Dinius is manager.

TERRE HAUTE, IND.—It is stated that an engineer has been engaged to prepare plans for a municipal electric light plant here.

RIDGEVILLE, IND.—The Ridgeville Electric Light, Heat & Power Company has incorporated with a capital of $10,000. The principal incorporators are Joseph Lay, S. C. Lay and Arthur Lay.

CRESTON, IA.—Mayor J. C. Sullivan is interested in the formation of a company, to install an electric light plant.

SIOUX CITY, IA.—A charter has been granted to Tilden & McRoberts, of Chicago, Ill., for a lighting, heating and power plant.

NATCHITOCHES, LA.—The Natchitoches Electric Light Company contemplates purchasing a new engine and dynamo. J. R. Carroll is superintendent.

PITTSBURG, KAN.—A franchise to establish an electric light plant has been granted to Morris Cliggitt.

WICHITA, KAN.—The Citizens' Light, Heat & Power Company, Wichita, Kan., is to erect a new power plant. H. G. Landis is interested.

CARLISLE, KY.—The plant of the Citizen's Electric Light & Power Company was destroyed by fire Feb. 18. C. F. Holderman is superintendent.

LAWRENCEBURG, KY.—W. E. Dowling, of the Commercial Club, writes that it is proposed to construct an electric light plant at a cost of $12,000.

CLOVERPORT, KY.—The Cloverport Water, Light & Ice Company has been incorporated. A. L. Fort and Lee E. Cralle, both of Louisville, are among the incorporators.

HARTFORD, KY.—Ike C. Adair has been elected president and J. D. Cooper, vice-president and general manager of the Kentucky Light & Power Company, recently formed to install an electric light plant at Hartford.

ABBEVILLE, LA.—Geo. W. Summers, secretary of Council, writes that it is proposed to construct water works, electric light plant and sewerage system, and the taxpayers will shortly vote on the question of issuing $45,000 bonds for the same.

BALTIMORE, MD.—Bids will be received March 8 by the Board of Awards for furnishing and operating electric arc lamps. Robt. J. McCuen is superintendent of lamps and lighting.

MELROSE, MASS.—At a meeting of the Melrose aldermen an order was passed authorizing the mayor to make a contract with the Malden Electric Company for lighting for one year from Feb. 1, the cost to be $12,256.

WORCESTER, MASS.—C. T. Sherer and Geo. Crompton are interested in the construction of an electric plant to supply light and power for the buildings in the square bounded by Main, Front, Commercial and Mechanic Streets., this city.

GROSSE POINTE FARMS, MICH.—The Village Council has under consideration the installation of an electric light plant.

ZEELAND, MICH.—It is proposed to install at the village electric light plant some time this season a 25-kw, 235-volt direct-connected unit.

SAULT STE. MARIE, MICH.—It is reported that about $1,000,000 will be expended by the Michigan Lake Superior Power Company for improvements.

ST. CLAIR, MICH.—This city contemplates installing a new boiler and new pumps at the electric light and water works plant. Walter Ash is chief electrician.

ROMEO, MICH.—It is proposed to install a 1500-light alternator and 45 arc light alternator at the village electric light plant. A 60-hp engine may also be purchased. B. N. Seaman is secretary of the light committee.

DOWAGIAC, MICH.—The citizens will, in the spring, vote on improvements to the electric light plant, to include the rebuilding of the pole line and rewiring the system which will call for about 20 miles of No. 6 W. P. wire; a regulator at the station with about 75-kw capacity; installing about 150 incandescent series lamps, etc. D. E. Connine is superintendent.

PONTIAC, MICH.—The Clinton River Power Company is to be organized as soon as a franchise can be secured from the city of Pontiac, Mich. The promoters now control 6 miles of the Clinton River and are in possession of the necessary funds to push the scheme as soon as a franchie is granted. The company will be incorporated for $100,000. Water wheels, alternating current dynamos and other equipment are required. Seeley & Son, Amy, Mich., are interested.

STILLWATER, MINN.—The plant of the Stillwater Lighting Company at South Stillwater was damaged by fire Feb. 21.

WIGGINS, MISS.—The Wiggins Electric Light Company has been incorporated with a capital of $10,000.

SEMINARY, MISS.—The Mason Lumber Company, of Platt Station, has decided to construct an electric light plant. It will also furnish lights for Seminary.

STURGEON, MO.—The citizens have voted to issue bonds for the construction of an electric light plant.

JEFFERSON BARRACKS, MO.—Bids are wanted March 17 for installing an exterior and interior electric lighting system here. Address Maj. Thos. Cruse, Depot Q. M., St. Louis.

BLAIR, NEB.—The Blair Electric Light & Power Company proposes installing a new boiler, direct-current generator and establishing a day circuit.

PERTH AMBOY, N. J.—The Citizens' Light, Heat & Power Company has been formed by J. K. Sheery, C. C. Hommann and others, with a capital stock of $125,000.

PASSAIC, N. J.—The City Council has under consideration the establishment of a municipal lighting plant and will probably petition the Legislature for permission.

BAYONNE, N. J.—The Council has adopted a resolution providing for the appointment of a committee to consider the question of constructing a municipal electric light plant.

ALBANY, N. Y.—The Albany Electric Illuminating Company has reduced the price of lighting current from 20 cents to 15 cents per kw-hour.

JAMESTOWN, N. Y.—It is proposed to install at the city electric light plant one 200-kw turbo unit and 50 street lights. C. G. Sundquist is manager.

NEW YORK, N. Y.—The Board of Estimate on Feb. 24 appropriated $600,000 to purchase a site and to begin the construction of the proposed municipal electric light plant.

ROCHESTER, N. Y.—The directors of the Eastern Monroe Electric Light & Gas Company have elected these officers: President, Andrew H. Bown; vice-president, Walter A. Parce; treasurer, Henry C. Brewster; secretary, Clarence E. Shuster.

NEW YORK CITY, N. Y.—Commissioner Oakley, of the department of water supply, gas and electricity, will invite bids for lighting the five boroughs of the city from March 15 to December 31, of this year, and he expects a material reduction on all bids.

JAMESVILLE, N. Y.—The Thomas Mullen Cement Company, of Jamesville, has in contemplation the construction of an electric plant, to be used for furnishing light and power to its works and also furnishing lighting and power for all the surrounding villages.

BUFFALO, N. Y.—A preliminary estimate of the cost of a municipal electric light plant shows that the total cost to build it on city lands, at the foot of Jersey St., would be $1,792,000. Each arc light would cost $72.20 per year and each incandescent lamp 6 cents per kw-hour.

ASHEVILLE, N. C.—The Legislature has granted this city permission to borrow money for an electric light plant. B. M. Lee is City Engineer.

LAS CRUCES, N. M.—The Las Cruces Electric Light & Ice Company has been incorporated by Ben L. Berkeley, Jos. Wilkinson, of El Paso; Theo. Rouault and Herbert B. Holt, of Las Cruces, with a capital of $50,000.

PORTSMOUTH, N. H.—Bids will be received March 25 by Mordecai T. Endicott, Chief of the Bureau of Yards and Docks, Navy Department, Washington, D. C., for furnishing and installing a 20-ton electric traveling crane at the navy yard here, at an estimated cost of $5000.

URBANA, OHIO.—Frank P. Torrence has petitioned for a franchise for a hot water heating and electric light plant.

CARROLLTON, OHIO.—The Carrollton Electrical Company will add a new dynamo, engine and boiler. E. L. Swann is manager.

LOVELAND, OHIO.—The City Council has granted H. C. Hubbell, of Toledo, a franchise to construct water works and an electric light plant here.

MIAMISBURG, OHIO.—Bonds to the amount of $19,000 have been sold, to be used for the merging of the electric light plant and water works into one.

LORAIN, OHIO.—The Board of Public Service has asked for estimates for machinery, etc., for a small municipal electric light plant, with sufficient power to supply lights for the city buildings.

READING, OHIO.—The Council is preparing to call an election to vote on issuing $25,000 for improvements to the electric light plant. C. V. Dils is secretary.

JAMESTOWN, OHIO.—The Jamestown Electric Light Company will install a new alternating-current generator for incandescent lighting. S. A. Brown is manager.

STEUBENVILLE, OHIO.—Frank S. King, city auditor, writes that the Council has under consideration the question of submitting to a vote of the people at the spring election, the construction of a municipal electric light plant to cost $180,000.

PRAIRIE CITY, ORE.—Dr. Carlton Faull and Alfred Curry, of Baker City, are reported to be negotiating for the purchase of the Prairie City electric light plant. If purchased, about $25,000 will be expended for improvements.

HOMESTEAD, PA.—A stock company has been formed by Geo. S. Debolt and W. S. B. Hays to construct an electric light plant.

TURTLE CREEK, PA.—The Rose Electric Light & Power Company, of Turtle Creek, has been organized. Wm. L. Ledger is president.

WILLIAMSPORT, PA.—The Citizens' Electric Company contemplates installing a 150-kw water power plant and a 300-kw fuel oil plant. J. Fisher is manager.

WAYNESBORO, PA.—The stockholders of the Waynesboro Light & Power Company have re-elected the present directors and the directors afterward re-elected: President, W. L. Minick; secretary, John W. Warehime; treasurer, M. E. Sollenberger.

McKEESPORT, PA.—The Peoples' Ice, Light & Storage Company, of this place, is installing two 425-kw, 2200-volt Bullock alternating-current generators, two 640-hp Erie Ball compound engines; Westinghouse exciter; General Electric converter and Walker switchboard panel, to furnish light and power for the town.

DALLASTOWN, PA.—The papers of incorporation of the Yoe, Windsor and Dallastown Electric Light Companies have been filed. Each corporation has a capital stock of $5000. The incorporators and directors are: Eli S. Nisely, Florin, Pa.; George R. Heisey, Lancaster; E. R. Heisey, Dallastown; The object of the companies is to furnish Dallastown, Yoe, Red Lion, and the surrounding territories with light, heat and power, or any of them by electricity generated at Red Lion, the companies having secured the old match factory at that place for their plant.

MARION, S. D.—The Town Council is considering a proposition submitted by J. A. Heeron & Company for the construction of water works and an electric light plant.

NASHVILLE, TENN.—The City Council has passed on second reading an ordinance appropriating $12,600 for purchasing a generating unit and $2,500 for purchasing an arc lamp transformer.

MADILL, IND. TER.—The Town Council has granted a franchise to F. W. Porter, of Whitehall, Wis., for an electric light plant.

SAN ANGELO, TEX.—U. G. Taylor, of San Angelo, is interested in the construction of an electric light plant at Angelo Heights.

TEXARKANA, TEX.—The Texarkana Gas & Electric Light Company has been disposed of by Messrs. Madill and Cullinane, the former owners of the securities, to Messrs. H. N. Morris, of Shreveport, La., and R. C. Dawes, of Chicago. The latter take charge at once.

FT. DOUGLAS, UTAH.—It is proposed to light Ft. Douglas by electricity, power to be furnished by the Utah Light & Railway Company.

PROVO, UTAH.—O. S. Buell, of Denver, Col., and W. B. Searle, of Provo, have made application to appropriate 2500 cu. ft. per second of the water in Green River to be used for the development of power; it is estimated that the contemplated works will cost $250,000.

COLONIAL BEACH, VA.—The Colonial Beach Electric Light & Power Company has secured a franchise for an electric light plant.

MANASSAS, VA.—The Manassas Illuminating Company has been incorporated with a capital of $5000. W. N. Lipscomb is president.

LEXINGTON, VA.—The Lexington Light & Power Company contemplates installing a 250-hp turbine, one 180-kw alternator and a 250-hp steam plant. D. C. Humphreys is vice-president.

KINGWOOD, W. VA.—It is proposed to purchase a new dynamo and rewire for the town electric light plant. J. H. Kramer is chief electrician.

TACOMA, WASH.—The City Council has passed an ordinance granting a power franchise to the Tacoma Railway & Power Company.

SEATTLE, WASH.—It is proposed to expend about $250,000 for extensions to the electric light system for domestic light and for power purposes. The work will be done under city superintendence and not let out by contract. J. D. Ross is engineer.

LANDER, WYO.—It is stated that the Clarissa Gold Mining Company will construct a power plant to cost about $80,000.

ST. THOMAS, ONT.—Bonds to the amount of $200,000 have been sold to be used for the purchase of the gas and electric light plant.

TORONTO, ONT.—The Ontario & Minnesota Power Company has been incorporated with a capital of $3,000,000 by W. E. Backus, of Minneapolis, Minn., R. A. Grant, of Toronto, and others, to develop water and other power for the transmission of electricity. The principal office is to be at Toronto.

OTTAWA, ONT.—A proposition is on foot to construct a water course and feeder at Dunnville and a raceway northward from the Grand River to Jordan, on Lake Ontario, for the purpose of developing electrical and hydraulic energy. It is also proposed to construct lines of wire, poles, tunnels and conduits for the transmission of light, heat and power. The Grand River & Western Power Company is the name of the company now applying to the parliament of Canada for a charter.

TORONTO, ONT.—At the annual meeting of the Toronto Electric Light Company, the report of the president showed that the income of the company for the past year was $752,315, and the expenses, including interest on debentures, amounted to $450,273, which left a balance of profit of $302,041 out of which were paid four quarterly dividends at the rate of 7 per cent. per annum, amounting to $187,965, leaving a balance of $114,076 to be carried forward to the credit of profit and loss. A reserve account has been created, and $300,000 has been transferred from profit and loss for that purpose. Considerable expenditures have been made looking toward the utilization of power from Niagara Falls, including underground conduits and cables.

The Electric Railway.

MONTGOMERY, ALA.—The Montgomery Traction Company has been placed in the hands of a receiver on the petition of the North American Trust Company of New York, in default of payment of the interest on $400,000. E. E. Winters was appointed receiver.

STOCKTON, CAL.—Plans are all perfected for rebuilding the Stockton Electric Railroad, of Stockton, Cal., operating 12 miles of line. In all, $300,000 will be expended upon this work. The improvement will extend to all parts of the system.

CANON CITY, COL.—The City Council has granted a franchise to George W. Baumhoff, of St. Louis, for the construction and maintenance of an electric railway in this city.

WASHINGTON, D. C.—The Washington Railway & Electric Company proposes to operate an electric automobile service in the district. Each vehicle will have a seating capacity of 24 persons. Mr. G. H. Harries is vice-president.

LINCOLN, ILL.—The Lincoln & Mount Pulaski Interurban Railway Company has been incorporated, with a capital stock of $25,000, by Herman S. Bekemeyer, John C. England and Joseph F. Beidler.

INDIANAPOLIS, IND.—The officials of the Consolidated Traction Company have decided to use the third rail system on its line, which is now building between this city and Crawfordsville. The company will ultimately extend the line from Crawfordsville to Danville, Ill.

JEFFERSONVILLE, IND.—An electric railway from Cincinnati to Louisville along the Ohio River in Southern Indiana is now assured. At a recent meeting the officers of the company, which was organized a year ago, took active steps to build the 100 miles of road at once.

LAPORTE, IND.—It is understood that the Elkins-Widner Syndicate of Philadelphia, is negotiating for the purchase and merging of the Chicago and South Shore Railroad Company, operating between this city and Michigan City; the Lake Cities Electric Company in Michigan City; the Michigan City Traction Company, and the Laporte Electric Company.

ST. LOUIS, MO.—St. Louis capitalists are in New York to raise money for the building of a trolley line from Kansas City to St. Louis. The Missouri Central Railroad, with a capital of $12,000,000, will operate the line if built.

CUMBERLAND, MD.—The Cumberland & Pennsylvania Railroad Company has made a proposition to the Cumberland Electric Company to connect its line with that of the latter named company and to equip its Eckhart branch line for electric operation.

AUBURN, N. Y.—The State Board of Railroad Commissioners is considering the application of the Auburn & Northern Railroad for a certificate of public convenience and necessity to construct an 8-mile electric railway from Auburn to Port Byron.

NEW YORK, N. Y.—The New York, New Haven & Hartford Railroad has let a $6,000,000 contract to the New York Contracting & Trucking Company for six-tracking and elevating the line from New York to New Rochelle. This line is to be operated by electricity.

SALISBURY, N. C.—The Salisbury & Spencer Railway Company has sold an interest in its system to the American Gas & Electric Company, of Providence, R. I., and it is stated that the line now under construction between Salisbury and Spencer will be completed and put into operation and an electric light system will be installed at Spencer.

ZANESVILLE, OHIO.—Ed. S. Martin, of Straitsville, has arranged for the financing of the Perry Electric Railway, Light & Power Company, which proposes to build from Zanesville to New Straitsville. First mortgage bonds to the amount of $1,400,000 will be sold. C. A. Donahue, of New Lexington; A. Bringardner, of Junction City; W. E. Finch, of Somerset, and E. S. Martin, of New Straitsville, are interested in the company.

SCRANTON, PA.—An electric railway running from Providence Square up through Chinchilla, Glenburn and Dalton, is in contemplation. Former Mayor W. L. Connell is at the head of the project.

JOHNSTOWN, PA.—The Northern Cambria Street Railway Company, which intends to build in this vicinity, has elected the following officers: President, W. H. Deulinger; vice-president, Rembrant Peale; secretary, James H. Allport.

NEW HOLLAND, PA.—The New Holland, Blue Ball & Terre Hill Company has been chartered. The capital stock is $36,000. The officers are: President, J. F. Seldomridge; J. B. Long, W. M. Franklin, Harry M. Weaver, Peter E. Shirk and Mr. Seldomridge.

PHILADELPHIA, PA.—A special meeting of the stockholders of the Philadelphia Rapid Transit Company will be held April 25 to authorize the company to join as guarantor to the $10,000,000 bonds of the Market Street elevated passenger railway.

BETHLEHEM, PA.—In asking for franchise of the Stroudsburg Town Council, Charles H. Latta, of this place, manager and treasurer of the Stroudsburg & Northampton Electric Railway, declared that his company is now ready to push the work and that his road would be equipped with the single-phase system.

SCRANTON, PA.—The Scranton, Factoryville & Tunkhannock Railroad Company has filed a mortgage for $2,000,000. The company proposes to build an electric railway from Scranton to Tunkhannock by way of Dalton and Factoryville. The president of the company is J. Selden Swisher, and the secretary, Charles Seely.

HARRISBURG, PA.—Among the charters granted at the State Department recently were the following: Rohrerstown, Landisville & Mt. Joy Electric Railway Company, capital $60,000; Charles K. Keller, of Lancaster, is president. The Waynesburg Street Railway Company, capital $12,000; Mr. R. Scott, of Waynesburg, is president.

PHILADELPHIA, PA.—The franchise of the Vandergrift Construction Company to build a $3,000,000 electric railway in Porto Rico from San Juan to Ponce has been revoked by the executive council. The reason given for this action is the inability of the company to fulfil its contract. The company was incorporated in 1889, and the franchise was granted a year ago.

OXFORD, PA.—The Oxford, Cochranville & Parkesburg Electric Railway Company is about to begin the construction of its road between Oxford and Parkesburg, Chester County, Pa., a distance of 14 miles, all the necessary rights of way and ordinances having been secured. Plans and specifications are now being prepared at the company's office, 808 Girard Trust Building, Philadelphia. Mr. John H. Myers is secretary.

WATERTOWN, S. D.—The Watertown Transportation Company has been organized with a capital of $100,000. Alfred L. Rowe and William D. Rowe are interested.

TEXARKANA, TEX.—Col. E. J. Spencer, president of the Texarkana Traction Company, has been in the city looking for a site on which to erect a power plant for his company. The company has been operating in conjunction with the Texarkana Gas & Electric Company, in whose plant it installed machinery to meet its needs. It is the purpose of the traction company to remove the machinery to its new plant.

BENNINGTON, VT.—The Bennington & North Adams Street Railway Company has been incorporated with a capital stock of $150,000. The officers are: President, A. H. Rice, Pittsfield; treasurer, O. M. Barber.

WAUSAU, WIS.—G. D. Jones, Karl Mathie, G. S. Gilbert and Neal Brown are interested in a project for an electric railway through the Wisconsin River Valley reaching Brokaw and Merrill and other points.

MADISON, WIS.—The Milwaukee & State Line Railway Company, of Milwaukee, has filed articles of incorporation in the office of the Secretary of State. The capital stock of the company is $10,000, and the incorporators are Chas. L. Lowe, Clarence B. Hale and John M. Mariga.

New Industrial Companies.

THE BRENNAN ELECTRIC CONSTRUCTION COMPANY has been organized at Chicago, Ill., with a capital of $5000. The incorporators are W. F. Brennan, J. P. Early and D. F. Cleary.

THE NEW ENGLAND ELECTRIC SUPPLY COMPANY, of Waterbury, Conn., has filed an organization certificate. Its officers are: President, A. M. Young, New York City; treasurer, A. O. Shepardson, Waterbury; and secretary, W. G. Morse, Waterbury.

THE INTERNATIONAL ELECTRIC APPLIANCE COMPANY, of Augusta, Me., has been formed with $50,000 capital. President and treasurer, I. L. Fairbanks, Augusta. Directors: as above, and L. A. Burleigh and J. Perry, of Augusta; Chas. Johnston and A. Todhunter, of Memphis, Tenn.

Legal.

METER PATENT DECISION.—Judge Buffington, of the United States Circuit Court for the Western District of Pennsylvania, on Feb. 25 granted an injunction restraining the Jefferson Electric Light, Heat & Power Company, of Punxatawney, Pa., from using a type of wattmeter claimed to infringe the Tesla split-phase patents. In this litigation the Diamond Meter Company, the manufacturer of the meter, undertook the defense of the case and entered the plea that it had been a party to the defense in a similar suit, in which the Court of Appeals held that the validity of the patents in question had not been established. Judge Buffington held, however, that the Diamond Company had not appeared openly as a party to the defense in the latter suit, that against the Catskill Illuminating Company, and ordered that a decree of infringement be entered against the Diamond Company.

BRUSH-HOLDER PATENT SUIT.—Judge Seaman, in the United States Circuit Court for the eastern district of Wisconsin, in an opinion handed down on Feb. 24, granted an injunction against the National Electric Company in a suit brought by the General Electric Company for infringement of the Erben brush-holder patent No. 705,055. This injunction is a sequel to a decree and injunction entered some time ago against the Christensen Engineering Company, in an action for infringement of the same patent, and restrains the National Electric Company, as successor to the Christensen Company, from the further manufacture or sale of the device in suit.

Obituary.

THE LATE E. F. PHILLIPS.

MR. EUGENE F. PHILLIPS.—We have great regret in announcing the death of Mr. Eugene F. Phillips, the founder of the American Electrical Works, who succumbed to pneumonia and heart failure, Feb. 22, at his home in Providence, after an illness of some three weeks. This well-known pioneer in the electrical industries was born in Providence, Nov. 10, 1843. While still a pupil in the high-school he enlisted in the Civil War, finishing his education when he returned from the front. He was engaged at first in banking, but afterwards turned his attention to the manufacture of insulated telegraph wire, a small shed constituting his work-shop. From this modest beginning he built up one of the largest industries of the kind in the country, being at the time of his death general manager of the American Electrical Works and president of the Washburn Wire Company, both of which have large plants at Phillipsdale, East Providence. Mr. Phillips began business in his own name as far back as 1870, and organized the American Electrical Works in 1882. In 1889 he established a plant of the same character in Canada at Montreal, where he had since carried on the largest business of its kind in the Dominion. Of late years he had given his two sons, Frank N. Phillips and E. Roland Phillips, an active share in the business, and the former has been president of the American Electrical Works for some few years past. The deceased was not only distinguished as one of the ablest manufacturers of insulated wire in the world, but had an intimate acquaintance with all the details of modern electrical development, all of which, except the earliest stages of the telegraph, came under his own observation as an interested observer. He not only knew all the pioneers, but by the character of his product was able to do much to facilitate and encourage electrical development. He was a man of most charming and engaging personality, with hosts of friends in every part of the country. For at least a score of years he gave the famous annual Rhode Island clambake, which took place in the fall of the year in the vicinity of Providence and was looked forward to with the keenest expectation. It was not until the electrical industries had outgrown the physical possibility of enabling him to include all of his friends and customers that he gave up this admirable annual festivity with much reluctance. Men came from all parts of the country and from Europe to enjoy this festive occasion and to share in the unbounded hospitality which always characterized it. Mr. Phillips leaves behind him a widow, who was Josephine J. Nichols, of Rehoboth, Mass., and the two sons, who, so admirably trained under his fatherly guidance, will now carry on the great industry committed to their care. The funeral took place on Feb. 26 at the Phillips mansion, 261 Waterman St. Notable among the many mourners were the members of the 10th R. I. Volunteers and the Veteran's Association, and numerous other Grand Army men. The veterans, Mr. Phillips' business friends and the men and women of the electrical factory sent flowers that hid the casket from view. The services were simple, and at their conclusion there was a long line of carriages in the procession to the cemetery. During the day the village of Phillipsdale was draped in mourning, and on the flagstaffs in the town the national colors were halfmasted. On Sunday morning Rev. William Carpenter preached a sermon in tribute to the lifework of Mr. Phillips. At Grace Church in Phillipsdale the afternoon service was omitted on account of the funeral, and there was no Sunday school, but in the evening all united in a memorial service.

COL. G. W. MILES.—We regret to note the death of Col. George W. Miles at the Memorial Hospital, Richmond, Va., on February 25. The distinguished soldier was, at the time of his decease, president of the Radford Water Power Company, of Radford, Va. The funeral services took place at the Methodist Episcopal Church, Marion, Va., on February 27.

MR. A. P. GODDARD, president of the Freeport Railway, Light & Power Company, a valued member of the National Electric Light Association, died at his home in Freeport, Ill., on Tuesday, February 12, at the age of 72. He was born in Franklin County, N. Y., but his family removed to Freeport when he was two years old. Mr. Goddard was prominently identified with the development of Freeport, having served as alderman, mayor, and member of the Board of Supervisors. He also served in the Civil War as first lieutenant in the Illinois Volunteer Infantry, and was brevetted a captain for honorable service. Mr. Goddard was a prominent freemason.

Personal.

MR. MAX LOEBELL, of the Engineering staff of Siemens & Halske, Berlin, sailed for Europe March 2 on the *Blucher*, after a visit in this country of several months.

MR. ISHAM RANDOLPH, chief engineer of the Sanitary District of Chicago, was in the East last week in connection with the proposed 16,000-kw Lockport, Ill., plant installation, the bids as to which are chronicled elsewhere in this issue.

MR. HENRY L. SHIPPY, treasurer of John A. Roebling's Sons Company, has just started on a trip to Mexico, where he will spend the month of March thus escaping the sharp winds of that period and tempering his isolation also by several good contracts.

MR. W. J. FERRIS, of the Chicago office of the General Electric Company, has resigned to take the management of the Independent Light & Power Company, of Quincy, Ill. Mr. Ferris, with his two brothers, is interested in several electric light and power plants in Illinois and Iowa.

MR. F. J. MOORE, who took charge of the telegraph office at Machias, Me., in 1852, has just been pensioned by the Western Union Telegraph Company, after 50 years of consecutive service, ending 1902. He has also been town treasurer for 25 years. He is a native of New Brunswick, and has been in the United States since youth.

MR. H. H. VREELAND.—The interesting address of President Vreeland, of the New York City Railway Company before the New York Electrical Society has been given very fully by the *New York Herald*. It is now being issued in pamphlet form and is well worthy of such presentation in permanent form, as a lucid, sober well-considered discussion of the relations of a great electric traction system to the public.

MR. CAMPBELL SCOTT, who was for many years prominent in the management of the C. & C. Electric Company, and whose resignation therefrom was announced recently in these columns, has now assumed the position of manager of the main works of the Otis Elevator Company, at Yonkers, N. Y. Mr. Scott has had considerable experience as a works director, and has many special qualifications for the responsible duties which he now takes up.

MR. F. D. PHILLIPS.—The numerous friends of Mr. F. D. Phillips will be pleased to learn that he has been appointed general manager of the American Electrical Supply Company, at 83-85-87 Fifth Ave., Chicago. Mr. Phillips' five years experience with the Electric Appliance Company, which institution has schooled so many competent men, and later as treasurer and sales manager of the Crescent Company, fits him admirably for the duties of his new position.

MR. R. G. BROWN, who was formerly well known in electrical circles in New York and Brooklyn has gone to the Pacific Coast, and has become a member of the active real estate and mining firm of Houston, Lock & Brown, of Los Angeles, Cal. He is also a member of the Los Angeles Realty Board. He informs us that H. E. Huntington and associates have spent $30,000,000 in developing the Los Angeles trolley system and will spend as much more on the suburban lines.

MR. J. K. ROBINSON, of Iquique, Chili, who represents Westinghouse and other big manufacturing interests on the west coast of South America, sailed last week for England for the purpose of conferring with the financial heads of nitrate and other industrial undertakings in Chili, who propose to adopt electricity in their plants. He is expected to arrive here in about a fortnight with a goodly batch of orders for equipment, etc. While in the States, Mr. Robinson makes his headquarters at the offices of the export house of William E. Peck & Company, 116 Broad Street.

MR. GEORGE A. McKINLOCK, president of the Central Electric Company of Chicago, is receiving the congratulations of his friends over the way his company resumed business after the fire which completely destroyed its storerooms on Feb. 11. Long before the fire was out, offices were established at 209 East Jackson Boulevard, about half a block from the old site, and in less than a week the casual visitor to these temporary quarters would not have been able to guess that the store had not been stocked up and doing business at that

place for several years. The surprise to those visitors who knew of the complete destruction of the company's store and stock can well be imagined and is naturally much enjoyed in a quiet way by Mr. McKinlock.

DR. RUDOLPH GAHL, formerly of the Electric Storage Battery Company, of Philadelphia, has associated himself with the Denver Laboratories—assayers, analysts and electrochemists—at Denver, Col. The members of the firm are Messrs. R. Gahl, H. C. Parmelee and C. H. Bryan. Dr. Gahl, who is well known to the electrochemical fraternity through excellent and extended research work in storage battery engineering, will devote himself especially to consulting work in connection with storage batteries and electrochemical engineering in general, since electrochemical methods are now attracting considerable attention of metallurgists in Colorado.

MR. D. H. SCRIBNER, who has been for the past year British Columbia district engineer for the Westinghouse Electric & Manufacturing Company, with headquarters at Vancouver, has gone to Chicago on a visit. It is expected that Mr. Scribner will take charge of the San Francisco agency of the Allis-Chalmers Company, with offices at 623 Kohl Building. The electrical end of the company's business, since the absorption of the Bullock Electric Company, has so far been carried on by the Wagner Bullock Electric Company of California; R. B. Elder, manager. Mr. Scribner's wide experience as an electrical engineer on the Coast will be of great value to the Allis-Chalmers management.

MR. H. C. HUTCHISON, whose resignation as publicity manager from the Cincinnati Gas & Electric Company was noted recently in this column, proposes to develop a business in some electrical specialties and to act as manufacturers' agent. He has been located in Cincinnati for the last ten years. He was formerly general superintendent and assistant general manager of the old Cincinnati Edison Company, and after the consolidation purchasing agent of the electrical department of the Cincinnati Gas & Electric Company. He then became general superintendent of the electrical department of the Cincinnati Gas & Electric Company and later superintendent of business promotion of the company, handling both the gas and the electrical output. He will be glad to hear from manufacturing concerns, as to his territory.

WILLIAMS-HIGGINBOTHAM.—Miss Helena E. Higginbotham, of Springfield, Mass., was married recently to Mr. Guy V. Williams, New York manager for the Bryan-Marsh Company. The bride, who is a well-known and talented young woman, has acquired a reputation in literary and art circles. She has not only written, but illustrated, for the magazines, being also the illustrator of Charles Clark Munn's "Pocket Island," as well as other works. She is the author of "Rover, the Story of a Calico Dog," a book that has had a very large sale, the illustrations also being by her. The novelty of this work has won for the author a host of admirers, the unusual nature of the work showing her to be a young woman of marked ability, as well as powers of imagination.

MRS. ELIZABETH FLEISCHMANN-ASCHHEIM, of San Francisco, who has won much fame by her work in radiography and X-ray treatments during the past eight years, is convalescing after an operation removing her right arm at the shoulder. She admits that almost constant exposure to the rays had much to do with the trouble, which finally necessitated amputation. On September, 1903, the end of a finger on her right hand was accidentally crushed. Continued exposure to the rays in the course of business helped to prevent healing and aggravated the X-ray burns which had affected both hands. For nearly a year past Mrs. Aschheim has taken great precautions while at work using rubber gloves and a plate glass screen to protect herself, but it was too late to repair the damage done during her earlier experiments. The leading medical and scientific men of the Coast are full of sympathy and regrets that Mrs. Aschheim has been forced to give up her eminent work as a radiographer in the midst of a brilliant career. It will be a serious loss to them to be deprived of her professional services in the most difficult cases for X-ray examination and radiography.

MR. FREDERICK P. FISH, president of the American Telephone & Telegraph Company, gave an address upon the telephone before the Beason Society at the new Algonquin in Boston on Feb. 28. He stated that in his opinion America had produced the three greatest inventors of the last one hundred years—Eli Whitney, inventor of the cotton gin; Robert Fulton, inventor of the steamboat, and Alexander Graham Bell, inventor of the telephone. He said that there are 200,000 instruments in New England, and that the operators at Boston guard 96,000 lines, with 4000 miles of wire, being as faithful public servants as any in the country. At the main office each girl attends to from 50 to 100 subscribers, with the utmost courtesy. The number of telephones installed at subscribers' stations has more than doubled in the last three years, as compared with the previous 24 years. Mr. Fish said that he was confident that the next three years would see the present figures more than doubled, and predicted that at no distant day the telephone will exceed the mail in the number of messages per day. To meet the needs of the service 1,000,000 trees a year are required for poles, and the average cost for every class of message is 2.2 cents, which is not much more on the average than the cost of mail messages.

News of the Trade.

BELDEN MFG. COMPANY has moved its Chicago headquarters to 192-194 Michigan Street, between State and Dearborn, where it will have a larger factory with better facilities.

REMOVAL.—The Century Electric Company, St. Louis, Mo., has moved to 404 North Fourth Street, that city, where it has much larger and better quarters than in the former location on Locust Street. In the new quarters the company will be better able to care for its rapidly increasing business in ceiling fans and power motors.

THE CHICAGO FUSE WIRE & MANUFACTURING COMPANY has removed its New York offices to 203 Fulton St., where it has increased facilities for handling its rapidly growing business. The company does repairing and emergency work. It carries a larger stock than it has ever been able to heretofore.

THE ROBBINS & MYERS COMPANY, of Springfield, Ohio, has recently opened a new office in Chicago at 1107 Fisher Building, and has arranged with Mr. C. H. Norwood to represent it in the Chicago territory in its line of "Standard" motors and generators. It will carry a complete stock of these goods in Chicago. Mr. Norwood is a man of wide experience and recognized ability, and will make a good representative.

THE HALLER MACHINE COMPANY, of Chicago, has discontinued the sale of its electric signs and appliances through agents, and will sell direct to customers. This action was deemed advisable in view of the fact that it will enable the company to keep in closer touch with its customers, which will undoubtedly result advantageously to all parties. It reports that the all-metal electric signs made by it in its factory at 127 Fulton Street is finding increased favor with the trade.

MERCURY ARC RECTIFIER AT THE SPORTSMAN'S SHOW.—In the exhibit of the Electric Launch Company is shown one of the General Electric Company's mercury arc rectifiers in full operation. It is used to charge 44 cells of battery in the electric launch "Rest Awhile," the current being 30 amperes at 110 volts, direct current; the alternating current used is 220 volts, 60 cycles. This presents an interesting field for the use of mercury arc rectifiers and it is probable that the use of electric launches may be materially increased by the simplicity of the charging outfit now offered.

THE J. L. SCHUREMAN COMPANY, which recently suffered a loss by fire of $35,000 in the destruction of its former factory at 133-139 S. Clinton Street, Chicago, has secured new quarters at 70 to 86 W. Jackson Boulevard. The new factory will occupy floor space several times in excess of that of the old one and this will insure the prompt filling of all orders. An entire new stock of goods has been ordered, and work on the new plant will continue night and day. By the second week in March the company will again be filling orders for elevator controllers, and other automatic motor controlling devices.

CENTRAL ELECTRIC COMPANY, Chicago, reports rapid progress in getting in a new and complete stock of electrical supplies since its fire, and states that it is now in a position to make good all promises of prompt attention to orders and inquiries. Normal conditions are restored and save the effects of new surroundings, business is moving forward in natural channels. The company is sending out to the trade a boooklet giving views of its present location and thanking the members of the electrical fraternity for their magnificent, generous and practical sympathy, which helped to sustain it under most trying conditions.

THE HYDREX FELT & ENGINEERING COMPANY affords the latest example of the great tendency of the times—specialization. This company, which has just commenced business at 120 Liberty Street, New York City, devotes its energies exclusively to the subject of waterproofing. This is a branch of engineering which has hitherto been comparatively neglected, but with the great activity in tunnel building and in structural work requiring deep foundations, and with the growing tendency of the engineer to burrow underground and also to keep the water from his superstructures, the importance of the subject now warrants the attention of specialists. This is the first company which, besides offering waterproofing material, also draws up plans and specifications and attends to the engineering details of this class of work. The manager of the new company is Edward W. DeKnight, who has taken a prominent part in preparing the plans for waterproofing a number of great engineering enterprises. The Hydrex Felt & Engineering Company starts business under favorable auspices, as "hydrex" felt has been specified for the Pennsylvania Tunnel under New York City, the B. & O.-Pennsylvania improvements at Washington and other important projects.

IMPORTANCE OF VENTILATION.—The importance of ventilation as a measure for health and the necessity of mechanical means for securing the desired results are emphatically presented by Mr. J. E. O. Pridmore in the Architectural Record for February. He states that in many theatres ventilation is so ignored that experiments have proved the air more foul than that in a street sewer. And further that "elaborate systems have been abandoned or mutilated because of the trifling cost of operation. Some of the most important theatres come in this class. I know of one whose splendid equipment became entirely forgotten through disuse. In another the manager inserted by-passes in the ducts to save the operation of a fan, and ruined its efficiency. I can name a celebrated American theatre whose manager acknowledged that he did not know which his house had, the up or the down draft system. Marked advance has been made in the past few years in the application of fans for the positive circulation of air in large buildings. When the public shows by its patronage of a well ventilated theatre that it prefers fresh air to foul air, other things equal, then, and not until then, will adequate means of ventilation be universally adopted.

RECENT HYDRO-ELECTRIC CONTRACTS.—The Pelton Water Wheel Company, of San Francisco and New York, reports a brisk trade in its product, quite a number of sales having been made to power companies operating steam plants, who desire to supplement their present equipment with Pelton wheels, direct connected to generators. On account of cost of maintenance and fuel for the steam plants, the water wheel governors, where the two stations are operating in parallel are arranged to lag behind the engine governors. In this way, the engines are favored when the load drops off, thus effecting a large saving in fuel. In several instances, the steam plants will be shut down entirely, the entire load being handled by Pelton wheels. The engines, however, will be held in reserve, in case of a shut down at the hydraulic station. Several recent sales referred to are: a 700-hp Pelton wheel for the hydraulic plant of the Grande Ronde Electric Company, of Oregon, which will close down the steam and water turbine plant immediately upon the completion of the new hydraulic station. The pressure under which the new wheel will operate is 877 feet. A 450-hp Pelton wheel for the Nanaimo Electric Light & Heating Company of British Columbia. This water wheel belts to a line shaft, now driven by steam engine, the latter will be used to help out the Pelton

wheel at periods of low water and peak load. The Silver Lake Mines, of Colorado, have ordered a 600-hp Pelton wheel to be direct coupled to a 400-hp Allis engine. The two prime movers will drive generators in the large power plant of this mining company. A 450-hp Pelton wheel unit is also under course of construction for the territorial government of Hawaii, besides a 900-hp unit for La Grande Water Storage Company of Oregon. Pelton combination needle and deflecting nozzles are used, the deflecting portions being handled by Sturgess and Lombard governors.

Trade Publications.

NERNST LAMP COMPANY, Pittsburg, Pa., has just issued an illustrated booklet containing a reprint of an article describing the Nernst street lighting system in Sewickley, Pa. The installation consists of 90 six-glower lamps of the out-door type, equipped with clear eight-inch globes. Reports indicate that the system as a whole gives good satisfaction, and is considered superior to the former system.

ALLIS-CHALMERS HYDRAULIC TURBINES.—Publication No. 112 of the Allis-Chalmers Company is a large page catalogue describing and illustrating the several types of hydraulic turbines built by this company. These types include the famous Escher-Wyss turbine, of which the most notable installation in this country is at Niagara. Another is the Francis type, which is stated to have almost entirely superseded the older Jonval and Girard turbines. Still another is an impluse turbine for high heads. Governors are also illustrated and described for use with each of these types.

INTER-POLE VARIABLE SPEED MOTOR.—Four circulars are at hand having for their subject the inter-pole variable speed motor manufactured by the Electro-Dynamic Company, Bayonne, N. J. One of these describes the motor in detail; two others give illustrations of the motor fitted to various machine tools, and the fourth circular gives a list of the various sizes made, which range from 1 to 20-hp. By means of the auxiliary poles the point of commutation is kept constant, thereby enabling the motor to work at speeds ranging from, say, 350 to 1400 r.p.m., and to withstand an overload of 100 per cent. without any sign of sparking at the commutator.

SWITCHING STATIONS.—In Bulletin No. 26, the North Electric Company, Cleveland, Ohio very fully describes its switching stations for small or isolated telephone exchanges. The subject is illustrated by 14 excellent halftones and two diagrams, the former showing the various pieces of apparatus and the latter circuit diagrams. This apparatus is constructed with the view to the convenience of small or isolated exchanges, which are usually located at remote points where they are not easily reached by competent inspectors. It is designed so that the operation can be safely entrusted to a person of limited experience, and at the same time require the least repairs.

PUMPING MACHINERY.—The latest catalogue of Henry R. Worthington (W-30) contains 132 octavo pages, devoted to pumps, condensers and water meters. The illustrations are of excellent quality, consisting of well executed half tones made from touched-up photographs. Every manner of pump is shown, from a single 2-in. steam cylinder pump up to a triple-expansion water works pumping engine, and including special forms, such as vertical sinking pumps, etc. In the portion of the book devoted to condensing apparatus a section is given to a discussion of such apparatus for steam turbines. Worthington apparatus for this service has been specially developed, both of the surface and the jet types.

W. N. MATTHEWS & BROTHER, of 801 Carleton Building, St. Louis, report that Stombaugh guy anchors have been adopted by the following departments of the United States government: The United States Army, United States Navy, United States River Commission and United States Signal Corps. These different departments use the anchors for various purposes; the army for anchoring electric light and telephone poles, as at Ft. Riley, Kan.; the Navy for anchoring wireless telegraph masts in Florida, Porto Rico, Cuba and Panama. The River Commission uses them for anchoring abatis on the Missouri and Mississippi rivers and the Signal Corps for anchoring signal poles. The new catalogue on Stombaugh guy anchors is ready for the mail. It has the appropriate title "Anchors That Hold."

WAGNER ELECTRIC MFG. COMPANY, St. Louis, Mo., has issued, in bulletin form, a reprint of a paper presented at a recent meeting of the Kansas Gas, Water & Electric Light Association by Mr. G. Percy Cole, entitled "Answer to some Central Station Questions about Single-Phase Motors." The advantageous features of the self-starting single-phase repulsion-induction motor are treated in a convincing manner, and it is stated that for compound lighting and power service, high-frequency, single-phase systems give thoroughly satisfactory results. Part II of the bulletin shows by means of numerous illustrations some of the applications of the Wagner single-phase motors. These applications include coffee roasters, meat choppers, ice cream freezers, dough mixers, linotype machines, centrifugal pumps and motor generator sets.

CENTRIFUGAL FAN BLOWING.—Some interesting facts regarding the endurance of a centrifugal fan blower were brought out in the discussion at the last meeting of the Pittsburg Foundrymen's Association, regarding the relative merits of the positive blower and the fan. It was stated by a representative of the Westinghouse Air Brake Company, that they installed six positive blowers in their foundry and after six months replaced them with fans. At this plant the iron is melted continuously and the blowers were compelled to operate 23 hours daily. The blowers were operated at a pressure of 16 ounces and at the beginning of a heat would run up to 20 ounces. Regarding the life of fans, he said that they had used a No. 9 fan for 15 years, and during that period it was operated 23 hours every day except Sunday and required no repairs whatever.

POOR'S MANUAL OF RAILROADS.—The January, 1905, edition of Poor's Railroad Manual Appendix has just appeared, giving a directory of officials of both steam and electric roads in operation in the United States, Canada and Mexico. A revised and comprehensive statement of the Rock Island system is included, in order to correct some erroneous impressions made by the 1904 edition, and to bring the statistical and financial exhibits up to a date a year later than those previously presented. The Ready Reference Bond List contains the following features: (1) Tables of dividends paid by (a) Steam railroad companies from 1897 to 1904, inclusive; (b) Street railroad companies from 1897 to 1904, inclusive, and (c) Industrial Corporations from 1897 to 1904, inclusive; and (2) Tables of annual meetings, of stock registrars and transfer agencies for the same classes of corporations.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, S. S. Stadtler, 39 S. 10th St., Philadelphia. Next meeting, Boston, April 26 and 27, 1905.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn. Next meeting, New York City, Sept. 19, 20 and 21, 1905.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

AMERICAN RAILWAY, MECHANICAL & ELECTRICAL ASSOCIATION. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, Montreal, Can., Sept. 5, 6 and 7, 1905.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Pennington, 2020 State Street, Chicago.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. S. Barstow, New York City and Portland, Ore.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Chattanooga, Tenn., May 17, 1905.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Montreal, June, 1905.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, George B. Tripp, Colorado Springs, Col.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

ELECTRICAL ASSOCIATION OF NORTH DAKOTA. Secretary, S. J. Fuller, Larimore, N. D.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, F. Fish, Rochester, N. Y.

ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association.) Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meet second Friday of each month.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, D. Davis, Litchfield, Ill.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES OF AMERICA. Secretary, Frank G. Jones, 48 West Jackson Boulevard, Chicago.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Annual meeting, second Thursday in January, 1906. Monthly meetings, second Thursday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting Erie, Pa., Aug. 29, 30 and 31, 1905.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. M. Coleman, Louisville, Ky.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. S. Porter, Eldora, Ia. Next meeting, Dubuque, Ia., April 19 and 20, 1905.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia. Next meeting, Des Moines, March 14, 1905.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, J. E. Davidson, Port Huron, Mich.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, Boston, July 19, 1905.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, Dudley Farrand, Newark, N. J. Next meeting Denver, and Colorado Springs, Col., June 6-11, 1905.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl Street, Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, T. S. Lane, 536 Ellicott Square, Buffalo, N. Y. Next meeting Albany, N. J., June, 1905.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Chas. Currie, Akron, Ohio.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Hotel Victory, Put-in-Bay Island, Aug. 16, 17 and 18, 1905.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, C. J. Miller, 620 Shorb Street, Canton, Ohio. Next meeting, Toledo, Ohio, May, 1905.

Pacific Coast Electric Transmission Association. Secretary, G. P. Low, 600 Rialto Building, San Francisco, Cal. Next meeting, Portland, Ore., June 20, 1905.

Pennsylvania State Independent Telephone Association. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings second Saturday of each month.

South Dakota Telephone Association. Secretary, H. B. Hartwell, Irene, S. D. Next annual convention, Sioux Falls, S. D., second Wednesday in January, 1906.

Southwestern Electrical and Gas Association. Secretary, C. W. Hobson. Next meeting, Denison, Tex., April, 1905.

Street Railway Accountants' Association of America. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

Street Railway Association of the State of New York. Secretary, W. W. Cole, Elmira, N. Y.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt.

Virginia Street Railway & Electric Association. President, R. D. Apperson, 723 Main St., Lynchburg, Va.

Western Society of Engineers, Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEBRUARY 21, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Atty's, 140 Nassau St., N. Y.]

782,826. ALTERNATING-CURRENT RECTIFIER; William B. Churcher, Cincinnati, Ohio. App. filed Sept. 3, 1904. (See Current News and Notes.)

782,828. MEASURED-SERVICE TELEPHONE-EXCHANGE SYSTEM; Henry M. Crane, New York, N. Y. App. filed Aug. 31, 1903.

782,857. PORTABLE CUT-OUT BOX; Anton T. Kligel and John H. Kligel, New York, N. Y. App. filed Aug. 4, 1904. A portable box having sockets in its ends for conductor terminals and a fuse compartment at the center.

782,863. ALTERNATING CURRENT MOTOR; Robert Lundell, New York, N. Y. App. filed Jan. 11, 1904. (See Current News and Notes.)

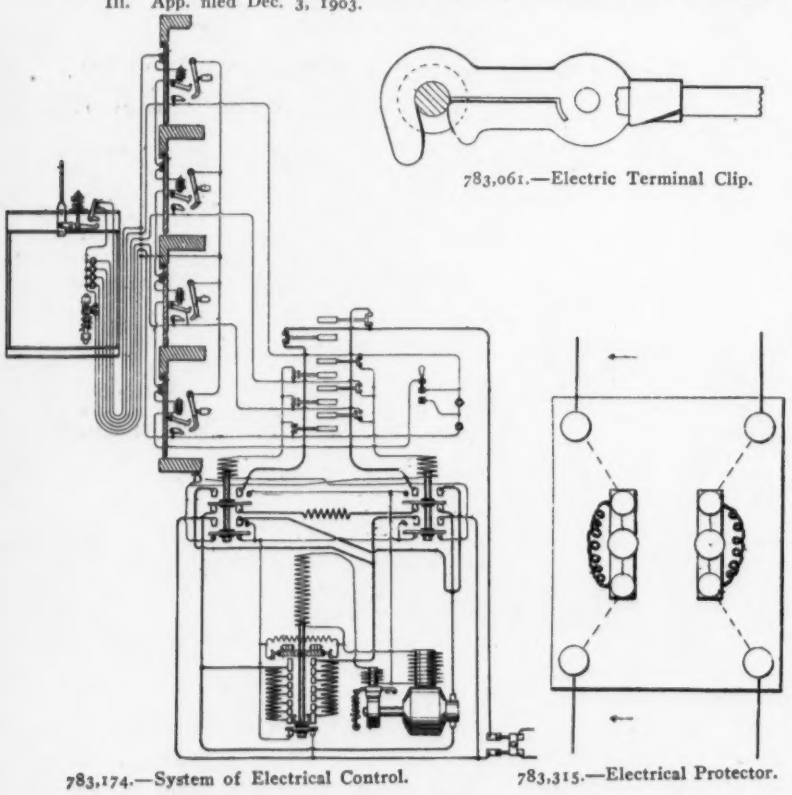
782,884. ELECTRIC SIGNALING APPARATUS FOR RAILWAYS; Thomas H. Traylor, Denver, Col. App. filed Nov. 9, 1904. Details.

782,887. RHEOSTAT; Hermon L. Van Valkenburg, Pittsburg, Pa. App. filed June 6, 1904. Plates of sheet metal are wrapped with insulating material and the resistance wire then wound on; the plates are stood on end radially about a common center.

782,892. TELEGRAPHIC REPEATING APPARATUS; William A. Athearn, New York, N. Y. App. filed May 13, 1904. A repeater for use in connection with an open circuit main line and a closed circuit extension line, the repeater being responsive to current changes in each or either circuit.

782,936. INSULATED STEP JOINT; George A. Weber, New York, N. Y. App. filed March 13, 1903. An insulating joint for different sizes of rails.

782,937. TELEPHONE EXCHANGE SYSTEM; Harry G. Webster, Chicago, Ill. App. filed Dec. 3, 1903.



783,174.—System of Electrical Control.

783,061.—Electric Terminal Clip.

783,315.—Electrical Protector.

782,944. MULTIPARTY LINE LOCKING OUT SYSTEM; Garrison Babcock, Chicago, Ill. App. filed Nov. 19, 1903.

783,001. RECIPROCATING ELECTRIC ENGINE; Bruno O. Wagner, El Paso, Tex. App. filed Sept. 22, 1904. A sectional solenoid having a coil wound armature and a commutating arrangement whereby the armature is caused to reciprocate inside of a solenoid.

783,014. BURGLAR ALARM; Glen R. Booth, Batavia, Ill. App. filed Sept. 20, 1904. Details.

783,027. ELECTRIC RAILWAY; Joseph De la Mar, New York, N. Y. App. filed March 8, 1904. The feed wire is located inside of a hollow third rail and mechanical switches are actuated by the train to switch current into the third rail at regular intervals.

783,028. ELECTRIC RAILWAY; Joseph De la Mar, New York, N. Y. App. filed June 9, 1904. The collecting device carries a roller that engages a sliding switch arm in the third rail to close the circuit to a section of the latter while another roller following the first, in a similar manner, opens the circuit.

783,057. ELECTRIC AIR DIFFUSING DEVICE; Timothy Mahoney, San Francisco, Cal. App. filed Nov. 26, 1904. An electric heater arranged in the frame of an electric fan so that the air is forced through it and heated.

783,061. ELECTRIC TERMINAL CLIP; David B. Mills, East Orange, N. J. App. filed May 3, 1904. A clamp having a seat for the conductor which is held in place by the resiliency of the clamp.

783,080. ELECTRIC COUPLING; Edward F. Ruth, Baltimore, Md. App. filed June 2, 1903. The coupling is used when a rescue car pulls or pushes a disabled car, so that the latter can be supplied with current for lighting and heating.

783,102. RECIPROCATING ELECTRIC MOTOR; Louis Casper, Chicago, Ill. App. filed March 23, 1903. Details.

783,107. APPARATUS FOR SEPARATING OILY OR SIMILAR IMPURITIES FROM WATER; Henry T. Davis and Ernest Perrett, London, Eng. App. filed March 29, 1904. An automatic valve controlling device adopted to prevent the entrance of oil that may be mixed with water, into a boiler.

783,124. MOTOR CONTROL SYSTEM; Maurice Milch, Schenectady, N. Y. App. filed Aug. 10, 1904. A motor adapted to operate by direct or alternating current having means for varying the number of turns of the field winding when the motor is transferred from one source of current to the other.

783,141. THERMO ELECTRIC SIGNAL; Martin J. Schick, Bellaire, Ohio. App. filed April 21, 1904. A thermometric tube is connected at intervals with a series of contacts, any one of which may be placed in circuit by a switch, so that an alarm circuit will be closed at a predetermined interval.

783,174. SYSTEM OF ELECTRICAL CONTROL; Eugene R. Carichoff, East Orange, N. J. App. filed Aug. 9, 1898. A comprehensive push button system of control for elevators.

783,197. MACHINE FOR INSULATING ELECTRIC CONDUCTORS; Charles H. Hawkins, Long Island City, N. Y. App. filed Aug. 2, 1904. Details of a machine for applying two coatings of insulating material to electric wires.

783,207. VIBRATOR FOR INDUCTION OR SPARK COILS; Arthur A. Kent, Philadelphia, Pa. App. filed Nov. 8, 1904. A vibrator removably pivoted and held yieldingly in position by a leaf spring which contacts with a contact screw and is given the required tension by means of another screw.

783,228. TROLLEY; Charles J. Sosenheimer, Allegheny, Pa. App. filed Aug. 11, 1904. Details of construction of the harp.

783,229. LOCKING INSULATOR; Louis Steinberger, New York, N. Y. App. filed March 19, 1903. A cap provided with a weather shield and with a metallic face arranged adjacent to the weather shield and adapted to be kept dry thereby.

783,230. INSULATOR SUPPORT; Louis Steinberger, New York, N. Y. App. filed May 11, 1903. The insulator comprises a metallic internally threaded sleeve of metal that screws over a threaded supporting pin.

783,231. HYGIENIC TELEPHONE RECEIVER; Louis Steinberger, New York, N. Y. App. filed Aug. 15, 1904.

783,268. ELECTRICITY METER; Hadyn T. Harrison, Westminster, Eng. App. filed Aug. 1, 1904. A device for registering the electrolyte, depending for its action upon the quantity of electrolyte supplied to the cell from time to time.

783,275. ATTACHMENT PLUG; Harvey Hubbell, Bridgeport, Conn. App. filed July 1, 1904. The Edison sleeve is so connected with the porcelain base as to prevent its being stripped therefrom in the turning operation.

783,279. SWITCH FOR SELECTIVE SIGNALING APPARATUS; Charles M. Jacobs, Maidenhead, and Arthur H. Nicholson, Wendover, England. App. filed April 18, 1904.

783,283. TELEPHONE RECEIVER; William Kaisling, Chicago, Ill. App. filed Feb. 19, 1903.

783,295. INCANDESCENT LAMP SOCKET; Normal Marshall, Newton, Mass. App. filed Nov. 26, 1904. An Edison adapter of such construction that when applied to a T-H socket, is prevented from being unscrewed.

783,302. AUTOMATIC TELEPHONE EXCHANGE; Nils Emel Norstrom, Junction City, Kan. App. filed April 10, 1900.

783,315. ELECTRICAL PROTECTOR; Charles A. Rolfe, Chicago, Ill. App. filed April 21, 1900. A number of shunts connected in parallel on a single circuit with a fusible cut-out controlled by one of the shunts.

783,333. WIRE TERMINAL OR LUG; George A. Tower, Henrico Co., Va. App. filed July 9, 1904. A clip formed of a single piece of metal and comprising a flat plate and a tubular part, the latter closed at its inner end.

783,340. TELEPHONE EXCHANGE SYSTEM; Harry G. Webster, Chicago, Ill. App. filed Dec. 5, 1903.

783,348. INSULATOR; Evans C. Wright, Portland, Ore. App. filed March 18, 1904. Details.

783,354. TELEPHONE SWITCH; Jesse M. Beever, Effingham, Ill. App. filed April 20, 1903.

783,376. ELECTRIC THERMO ALARM; Percy C. Howe, Cambridge, Mass. App. filed April 23, 1904. A fusible plate normally covers a cavity containing the circuit closer; the destruction of the plate affords access of the heat to the circuit closer.

783,388. ELECTRICAL CIRCUIT PROTECTOR; Charles A. Rolfe, Chicago, Ill. App. filed Jan. 2, 1902. An attachment to an ordinary fuse whereby continuance of a grounded current will fuse a material that normally holds separated two short-circuiting arms.

783,389. TELEGRAPH RECEIVER AND RECORDER; Willis J. Roussel, New Orleans, La. App. filed April 9, 1904. Details.

783,397. WINDING FOR DYNAMO-ELECTRIC MACHINES; Bernard A. Behrend, Norwood, Ohio. App. filed Nov. 5, 1903. (See Current News and Notes).

783,398. DYNAMO ELECTRIC MACHINE; Bernard Arthur Behrend, Norwood, Ohio. App. filed Nov. 24, 1903. (See Current News and Notes.)

783,399. BURGLAR ALARM; Henry Blank, Richmond Hill, N. Y. App. filed Dec. 21, 1903. Details.